ESSAYS ON POLICY REFORMS IN TRADE, INVESTMENT AND TAXATION

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DECLARATION

I certify that this is my own original work except where otherwise acknowledged in the text. Chapters II and IV have been issued as Policy Research Working Papers by the World Bank:

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SWARNIM WAGLÉ

Swarnim Waglé
December 2011

Dedicated to my mother

1953–2003

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ABSTRACT

This thesis consists of three essays on trade, investment, and taxation that are unified by their policy relevance to developing countries. Following an introductory chapter on policy reform, the first essay revisits the institutional determinants of foreign direct investment (FDI) using a comprehensive new data set covering more than 80 countries. It exploits the presence of confirmed zero investment flows between countries to estimate productivity cut-offs of firms that invest abroad profitably. This approach corrects likely biases arising from firm heterogeneity and country selection in a theoretically derived gravity-type model. The analysis finds inward FDI to be highly responsive to cross-country variation in specific institutional provisions, such as arbitration of disputes and legal procedures to establish foreign subsidiaries. The importance of FDI-specific regulations stands out even after controlling for the *general* quality of institutions. Statutory openness to FDI, however, has no association with actual inflow of investment.

The second essay examines cross-national differences in the survival of exports through the lenses of product, industry, and country characteristics. The estimates are derived from a new application of discrete-time models instead of the continuous-time (Cox) models that are standard in trade duration analysis. The examination of exports originating in more than 100 developing countries covering 4000 products over 12 years shows that export flows are much more fragile than suggested by trade theory. Using new measures of product sophistication and export diversification, the paper finds evidence of information and network externalities that aid export survival. Exports concentrated in a few industries or in a narrow range of destination markets exhibit higher rates of death, whereas export concentration *within* some industries is positively associated with survival, suggesting a synergistic network effect. The probability of export death *decreases* with proximity from the capital content of products to the national factor endowment,

competitive real exchange rate, and bilateral trade preferences. Further, death rates for dynamic subsets of exports like manufactured components and processed food differ from other products, belying the notion that short durations are necessarily a result of poor exporter capabilities.

The third essay assesses the revenue implications of coordinated tariff and tax reforms. It is shown for a sample of low-income countries over 25 years that they have had a mixed record of offsetting reductions in trade tax revenue, and that Value-Added Tax (VAT) has, at best, played a limited role. The paper then analyzes the specific case of Nepal, using a unique data set compiled from unpublished customs records of imports, tariffs, and all other taxes levied at the border. It estimates changes to revenue and domestic production associated with two sets of reforms: i) proportional tariff cuts coordinated with a strictly enforced VAT; and ii) proposed tariff cuts under a regional free trade agreement. It is shown that a revenue-neutral tax reform is conditional on the effectiveness with which domestic taxes are enforced. Furthermore, loss of revenue as a result of intra-regional free trade can be minimized through judicious use of Sensitive Lists that still cover "substantially all the trade" as required by Article XXIV of the General Agreement on Tariffs and Trade (GATT).

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

AGOA African Growth and Opportunity Act

ARF Agricultural Reform Fee

ASEAN Association of Southeast Asian Nations

AVE Ad Valorem Equivalent

BIT Bilateral Investment Treaty

BRIC Brazil, Russia, India, and China

BTA Bilateral Trade Agreement

CEPII Centre d'Etudes Prospectives et d'Informations Internationales

CES Constant Elasticity of Substitution

CGE Computable General Equilibrium

COMTRADE Commodity Trade Statistics Database

DWH Durbin-Wu-Hausman

EU European Union

FDI Foreign Direct Investment

G-20 Group of Twenty

GATT General Agreement on Tariffs and Trade

GDP Gross Domestic Product

GMM Generalized Method of Moments

HH Hirschman-Herfindahl

HS Harmonized Commodity Description and Coding System

ICRG International Country Risk Guide

IAB Investing Across Borders

ICT	Information and Communication Technology
ISIC	International Standard Industrial Classification
IV	Instrumental Variables
KM	Kaplan-Meier
MFN	Most Favored Nation
LDC	Least Developed Countries
NBER	National Bureau of Economic Research
NLS	Non-linear Least Squares
OECD	Organisation for Economic Cooperation and Development
OLI	Ownership-Location-Internalization
OLS	Ordinary Least Squares
PCA	Principal Components Analysis
PH	Proportional Hazard
PPML	Poisson Pseudo Maximum Likelihood
PTA	Preferential Trade Agreement
RCA	Revealed Comparative Advantage
RFI	Revealed Factor Intensity
ROW	Rest of the World
SAFTA	South Asian Free Trade Area
SITC	Standard International Trade Classification
SL	Sensitive List
TRIST	Tariff Reform Impact Simulation Tool
2SLS	Two-Stage Least Squares
UNCTAD	United Nations Conference on Trade and Development
US	United States

USTR United States Trade Representative

VAT Value-Added Tax

WDI World Development Indicators

WGI World Governance Indicators

WTO World Trade Organization

1

INTRODUCING THE THESIS

> "The desire to put mankind into the saddle is the mainspring of most economic study."
>
> – Alfred Marshall, *The New Cambridge Curriculum in Economics*, 1903[1]

1.1 CONTEXT

The themes of trade, investment, and taxation have a rich historical root, a strong foundation in economic theory, and direct application to policy making. I write my three essays on these themes because they represent an irresistible trinity for a student of development economics. Research insights from these fields are frequently translated into testable hypotheses, and applied as policy in countries in ways that influence their pace of progress. The disadvantage of working on fields that are beyond nascency, however, is that so much has been written on them that it is a challenge to find ones niche in the literature. I seek my niche in *new* data and empirical methods that have a close link to theory and relevance to policy.

This thesis consists of three papers. The first paper deals with the determinants of foreign direct investment[2] with an emphasis on the role of institutions. It analyzes the most comprehensive cross-country data set to date on FDI regulations. It does so using a technique that is not only derived from economic theory,

1 See Marshall (1903). This quote is related to lines from Ralph Waldo Emerson's poem, *Ode, Inscribed to William H. Channing*: "Things are in the saddle/and ride mankind," in Emerson (2006).

2 Foreign direct investment is a category of cross-border investment that involves residents of one economy obtaining a lasting interest in an enterprise located in another economy. A lasting interest is commonly understood to involve at least 10 percent of ordinary shareholding or voting power (International Monetary Fund 1993). In effect, FDI need not entail much transfer of funds, and might involve a foreign firm bringing its brand, technology, management and marketing strengths to bear on its local interest.

but also addresses methodological concerns that past empirical approaches have not taken seriously.

The second paper examines the role of export diversification, product sophistication, comparative advantage, trade preferences, and real exchange rate in the longevity of exports. I compute the length of export durations originating in more than 100 developing countries[3] covering 4000 products over 12 years to find that export flows are much more fragile than suggested by trade theory. I focus on the "sustainability margin" of export performance because export growth occurs not only through new products and new markets, but also by sustaining ties that already exist.

The third paper explores the revenue implications of coordinated tariff and domestic tax reforms in low-income countries. I show that a politically feasible way to apply sound theory to durable reform is to incorporate the structural characteristics of low-income countries, and demonstrate the viability of alternative policy scenarios. This is done through a combination of theory, cross-national evidence, and policy simulations using detailed country-specific data at the transaction level from Nepal.

1.2 SEEKING NUANCE WITHIN PARADIGM SHIFTS

There is little disagreement today among mainstream economists on the indispensability of sustained economic growth for reducing poverty. Although there is no consensus on how to achieve sustained growth, the contours of a new paradigm have emerged after distilling the diverse development experiences in the 20th century. First, fast-growing economies are oriented towards greater participation in international trade and investment. Second, the quality of institutions at home –

3 In this thesis, "developing countries" are those defined by World Bank (2011*b*) as belonging to low-income and middle-income categories as of July 2011. I exclude small developing countries with a population of less than one million in 1998. Low-income countries and "poor" countries are used interchangeably. All poor countries also belong to the list of 48 least developed countries (LDCs) defined by United Nations (2011). Not all LDCs, however, are low-income. For example, Equatorial Guinea is an LDC in the UN classification, but it is a high-income non-OECD country in the World Bank classification.

rule of law, contract enforcement, property rights, control of corruption, mechanisms to resolve conflicts, prudent regulations – underpins development in the long run. Third, policies that maintain macro-economic stability are conducive to growth. And fourth, infrastructure in terms of software (people's skills) and hardware (roads, ports, and energy) is vital.[4]

The discontent within the new paradigm, it appears, lies more in nuance and moderation than in core substance. For example, growth is good, but "inclusive" growth is better because jobs are created and the poor benefit too, lessening inequality in society. The exact magnitude of cross-national relationship between openness and growth is contested, but autarky or models of self-sufficiency stand thoroughly discredited. Pro-business regulations are fine, but they ought not be enacted radically at the cost of dismantling social safety nets. Along these lines, the three essays in this thesis, described next, are firmly situated in the new paradigm, but my aim is to search for nuances within it.

1.2.1 *Investing Across Borders*

The debate on the role of FDI in economic development has evolved over the past four decades, moving from ideological opposition to enthusiasm for at least some forms of FDI. In the 1970s, concerns over FDI centered on i) their mobility across borders, hence evasion of authority of both host and home states; ii) possible anti-competitive threats posed by large multi-national enterprises; iii) insecurity of benefits in the host countries regarding employment, taxation, and technology transfer;[5] and iv) the "perverse" cultural influence of foreign enterprises (McCulloch

4 These four points are consistent with the findings of the Commission on Growth and Development (2008) which summarizes five ingredients for economic growth as follows: i) public investment that *accumulates* infrastructure and skills; ii) capacity to *innovate* and *imitate* to do new things; iii) undistorted prices that *allocate* capital and labor effectively; iv) policies that *stabilize* the macro-economy; and v) equality and equity of opportunities for a society that is *inclusive*.

5 Multi-national enterprises are often accused of declaring profits in tax havens to escape the tax burden in host states, and introducing capital-intensive methods of production limiting employment generation. Little (1999, p. 161) finds that these economic arguments "greatly exaggerate the differ-

1979; Little 1982). Today, countries compete aggressively to lure FDI even when the gains are known to be context-driven and spillover benefits depend on host country characteristics. FDI, for example, is likely to improve efficiency only if the economy is already liberalized (see Balasubramanyam et al. 1996; Moran et al. 2005).

In the first paper, I explore the policy and institutional determinants of FDI using a new data set, Investing Across Borders (IAB) 2010, from World Bank Group (2010) on regulations that govern FDI in 87 countries. I use a theoretically derived gravity-type model, which is estimated using a methodology that corrects for two possible biases: "heterogeneity bias" that occurs when models do not account for the fact that investing firms differ widely in terms of productivity; and "selection bias" that arises when statistical controls for numerous country pairs that record a zero investment flow with each other are not incorporated. I find inward FDI to be highly responsive to cross-country variation in specific institutional provisions, such as arbitration of disputes and legal procedures to establish foreign subsidiaries. The importance of FDI-specific provisions stands out even after controlling for the *general* quality of institutions proxied by measures of rule of law, corruption, political stability, governmental effectiveness and regulatory quality. I find, however, that statutory openness to FDI has no association with actual inflow of investment. These results are robust to different empirical specifications.

1.2.2 *Analyzing Trade Survival*

To promote exports on a sustained basis, and not just in spurts through piecemeal reforms, policy makers are advised to look at all aspects of export performance, especially margins of growth that have been under-appreciated or ignored. Brenton, Pierola and von Uexkull (2009) find that countries that have rapidly diversified exports appear to outperform those that are diversifying slowly, not in introducing

ence between indigenous and foreign enterprise...problems of monopoly, technology and products arise in either case...both do harm in over-protected markets."

new exports, but in sustaining exports after they have been introduced. Policies that determine the survival of exports are, therefore, no less important than those that encourage innovation of new product lines or search for new markets through trade negotiations.

In the second essay, I explain cross-national differences in the survival of exports through the lens of product, industry, and country characteristics. I use new measures of sophistication of more than 4000 manufactured products and export diversification in more than 100 developing countries between 1997 and 2008 to find evidence for information and network externalities from exports that aid survival. The estimates are derived from a rigorous, new application of discrete-time models instead of the continuous-time (Cox) models that are standard in the literature on trade duration analysis.

I find that exports originating in countries with concentrated industries or dependent on a narrow range of destination markets exhibit higher rates of death, whereas export concentration *within* some industries is positively associated with survival, suggesting a synergistic network effect. The probability of export death *decreases* with proximity of the capital content of products to national factor endowment, competitive real exchange rate, and bilateral trade preferences. Further, death rates for fast-growing, dynamic subsets of exports like parts and components and processed food differ from other products, belying the notion that short durations are necessarily a result of poor exporter capabilities.

1.2.3 *Coordinating Tax Reforms*

Historically, the themes of trade and public finance are two of the most enduring in economics.[6] This is because of their intertwined relationship with national

6 A broad understanding of trade subsumes investment because the analytical concepts concerning the movement of goods, services, and capital are similar. Foreign direct investment in sectors like telecommunications, banking, and electricity are governed by rules on trade in services in the World Trade Organization (WTO). Also recall that, like trade, foreign direct investment has been practiced

prosperity, statecraft, and the functioning of governments. Kautilya, the author of *Arthashastra*, c. 300 BCE, counseled wisely on trade and revenue practices for an ancient age (Waldauer et al. 1996).[7] Nearly 2000 years later in 1662 William Petty "proposed innovations to improve efficiency, equity, and capacity to augment tax revenue" in *A Treatise of Taxes and Contributions* (Madisson 2007, p. 255).[8] Around the same time mercantilists were lobbying for (misguided) trade policies that maximized exports, minimized imports, and equated national wealth with the accumulation of bullion.[9] One of the most influential thinkers remains Adam Smith who extols the virtues of foreign commerce, systematically attacks mercantilism, and offers insights into revenue generation in the *The Wealth of Nations* (1776).[10] After Smith, other great economists from Ricardo and Marx to Marshall and Keynes have also written on these themes.

Modern economic theory supports a switch of taxation from international to national sources of production and exchange on grounds of efficiency. Trade taxes introduce a wedge between foreign and national prices, thereby distorting incentives and resource allocation. Because they encourage activities in sectors that are viable only at prices above the world average, the theoretical consensus is that domestic (consumption or income) taxes are superior to trade taxes. Domestic consumption taxes can meet the government's revenue target with lower rates, a wider base, and without a protectionist bias. However, low-income countries hesitate to reduce distortionary taxes on international trade. This is because they are concerned about short-term adjustment costs arising from the loss of tax revenue. The

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throughout history. From the merchants of Sumer c. 2500 BCE to the East India Company in the 17th century, investors routinely opened branches in foreign dominions (World Bank Group 2010).

7 Kautilya offered guidance for the king's Superintendent of Commerce on the export of state-owned commodities, urged a reasoned regulation of imports, and developed principles for an ideal tax system that emphasized convenience of payment, ease of calculation and administration, and fairness in burden.

8 This period marks the beginning of European ascent in the pursuit of scientific knowledge. The Royal Society was founded in England in 1660 and chartered in 1662. *Academie Royale des Sciences* was founded in France in 1666. Isaac Newton published *Principia Mathematica* in 1687.

9 Thomas Mun's *England's Treasure by Forraign [sic] Trade*, published posthumously in 1664, articulates the mercantilist position well (Mun 2003).

10 Eight of the nine chapters in Book IV of Smith (1994) critiques mercantilism; Book V is on revenue and the role of the state.

collection costs of border taxes are also much lower than what it would cost to implement a modern consumption tax like the VAT.

In the third essay, I present a case for coordinated trade-fiscal reforms, accepting that a revenue-neutral switch from trade taxes to domestic consumption taxes is fraught with implementation challenges in poor countries with a large informal sector. I show for a sample of 40 countries over 25 years that low-income countries have had a mixed record of offsetting reductions in trade tax revenue, and that VAT has, at best, played a limited role. I then analyze the specific case of Nepal, one of the world's poorest countries. Using a unique data set compiled from unpublished customs records of imports, tariffs and all other taxes levied at the border, the paper estimates changes to revenue and domestic production associated with two sets of reforms. First, proportional tariff cuts coordinated with a strictly enforced VAT are found to increase total revenue. Second, intra-regional free trade is shown to lead to a major loss of revenue that can only be recovered with an across-the-board increase in the domestic tax base or minimized through judicious use of Sensitive Lists that still cover "substantially all the trade" as required by Article XXIV of the GATT.

1.3 LINKING THEORY AND EVIDENCE TO POLICY REFORM

As stated at the beginning of this introduction, the topics of trade, investment, and taxation occupy a central place in development economics. Both the theory and the empirics in these fields frequently form an intellectual foundation for policy reforms in developing countries. The essays in this thesis combine theory and empirical evidence to suggest certain policy directions. To attract FDI, policy openness is necessary but it is de facto institutional reforms that is more important. In the short run, it is FDI-specific provisions that are associated more strongly with FDI inflow than the average country-wide quality of institutions measured by, say, the rule of law or corruption. For export growth, understanding what contributes to the survival of existing exports is no less important than experiments with new product lines and markets. In public finance, reduction of distortionary taxes is necessary, but this has to be sequenced and coordinated with alternative sources of revenue identified ex ante.

Pritchett (2009) describes policy as a conditional mapping from states of the world to actions, and policy action as the application of policies to the realized states of the world. He makes a useful distinction between *policy*, *policy action*, and *policy outcome*. Framed this way, the challenge in development policy making is three-fold: i) to garner sufficient consensus for "good policies" that have a positive foundation and a normative justification; ii) to accept heterogeneity and avoid a policy straitjacket in areas where consensus is lacking; and iii) to implement reforms and produce results as originally intended. The implication is that while research helps narrow down a list of policy options, there is no guarantee that policy action follows to produce the desired outcomes. I close this chapter with some remarks on these generic challenges.

The first challenge is in getting the theoretical underpinnings of policy right. Suitably sub-titled "how we learn," Krueger's 1997 article explains the dramatic change in ideas on trade and development over the past 40 years (Krueger 1997). She shows how application of good theory can go awry,[11] and argues that that could only be redressed over time with the aid of three factors: i) new research challenging stylized facts and evaluating the evidence from specific policy regimes, such as import-substitution;[12] ii) theory being refined to incorporate behavioral and institutional variables, leaving less room for misinterpretation; and iii) alterna-

11 Krueger argues that the mistakes economists made were i) misapplication of good theory; ii) focus on negative results, which means that more emphasis was given to exceptions under which a certain proposition failed rather than the general validity of the proposition; and iii) over-extension of good theory that concluded with dubious stylized facts.

12 Bhagwati & Srinivasan (1999) cite in this regard the intellectual value of detailed country-level studies pursued under the aegis of the Organisation for Economic Cooperation and Development (OECD), the National Bureau of Economic Research (NBER) and the World Bank in the 1960s and 1970s. Also see Little (1999) for personal recollections of his role in challenging entrenched viewpoints on trade and industrialization as a contributor to some of these studies.

tive policies being demonstrated as being viable in the light of experiences drawn from fast-growing developing countries.[13]

The second challenge is the failure to acknowledge heterogeneity in policy choices. There may be more than one path to good policy action and the most optimal of these may not be known beforehand. For example, economists know much more about the causes of long-term income differentials across countries than the pace at which to pursue reforms that either trigger *or* sustain growth.[14] The risk of failure can be minimized if policies are tailored to the specific contexts and circumstances of countries.

As Rodrik (2008) clarifies, this does not mean that economics works differently in poor countries. People do respond to incentives everywhere, but it is the environments in which consumers and investors find themselves that affect the scale of opportunities and constraints. Rodrik (2008, p. 6) contends that while first-order economic principles of "market-based competition, protection of private property, appropriate incentives, and sound money" are desirable, how they map into policy actions differs across contexts. When it comes to specific policy prescriptions, professional biases intervene with, say, a trade economist seeing major problems in the lack of openness or a labor economist seeing the biggest problem in labor rigidities. This diversity in professional opinion often leads to a shopping list of demanding reforms that developing countries do not have the capacity to implement. This is what inspired the "diagnostics" approach where reforms are sequenced to target the most binding constraints (Hausmann et al. 2008).

The third challenge is not so much getting the theory right, but avoiding half-hearted implementation of reforms that are generally accepted as sound. Ed-

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13 In the Australian context, Leigh (2002) describes how the intellectual underpinnings for major tariff reductions initiated by leaders of the Labor Party in 1973, 1988, and 1991 were provided by the Productivity Commission (in its prior form as the Tariff Board, the Industries Assistance Commission, and the Industry Commission) building on the work of theorists like W. Max Corden on the effective rate of protection.

14 *Triggering* growth and *sustaining* growth are often different goals. Growth can be triggered with a limited set of reforms, but sustaining it requires an institutional overhaul that, among other advantages, handles shocks better and fosters productive dynamism (Rodrik 2008).

wards (2010) argues that in a second-best world with inter-connected distortions, the effect of reforms is not additive: a little more of any reform is not always better than none. Ideally, reforms should be complete, with the concerns of potential opponents managed in advance. In some countries, cultural and historical factors constrain the political feasibility of reforms. Edwards (2010) connects the difficulty of implementing reforms with Latin America's disappointing growth experience.[15] He emphasizes, for example, the role that the real exchange rate misalignment resulting from currencies pegged at artificially high levels with the US dollar played in the stagnation of manufactured exports and in triggereing economic crises through unsustainable budget deficits. The problems were known, yet reforms failed to redress the known causes of economic distress.

Related to the third challenge above are reforms producing results not intended by policy makers. Thomas & Grindle (1990) and Grindle (2001) explain this as often being the case when policy reforms do not have an implementation strategy which anticipates opposition from vested interests affected by the change in the status quo.

Above all else, the genesis of most meaningful reforms is in the force of an idea whose time has come. While academic research like this contributes to fragments of such ideas, the linkage between ideas and sound policy is only as effective as the Sherpas that shepherd it through the politico-bureaucratic process into action and outcome.

15 According to Maddison (2007, p. 104), in 1820, the average GDP per capita of the United States and Canada was 1.5 times that of the eight major Latin American countries (Argentina, Brazil, Chile, Colombia, Mexico, Peru, Uruguay, and Venezuela); by 2003, the divergence was by a factor of 4.2.

2

INVESTING ACROSS BORDERS: DO FDI-SPECIFIC REGULATIONS MATTER?

"Happy families are all alike;
every unhappy family is unhappy in its own way."
– Lev Nikolayevich Tolstoy, *Anna Karenina*, 1878

2.1 INTRODUCTION

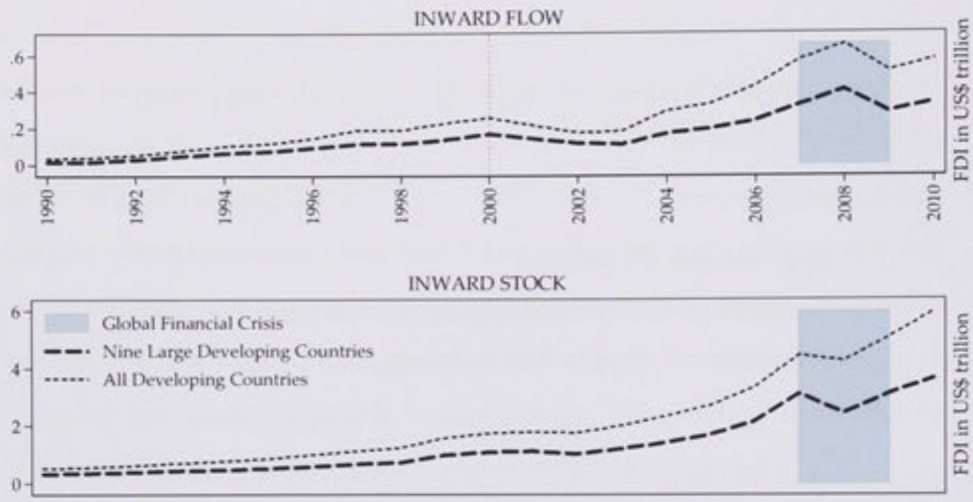
Foreign Direct Investment (FDI) remains one of the most important forms of cross-border capital flow into developing countries: in 2009, FDI inflow amounted to more than US$510 billion, exceeding inward remittance (US$307 billion) and development aid (US$91 billion).[1] As shown in Figure 2.1, however, just nine countries have accounted for about 60 percent of FDI inflow into developing countries over the past decade.[2] In an era when almost all countries in the world welcome FDI, allowing full foreign equity ownership in most sectors (Table 2.22), this cross-country asymmetry deserves explanation that is beyond the obvious such as countries' sizes and growth prospects.

In this paper, I focus on the policy and institutional determinants of FDI using a new cross-country data set drawn from World Bank Group (2010). The data set consists of indicators of FDI regulation that specifically measure each country's i) openness to foreign investment by sector; ii) quality of institutions related to

1 The figures on FDI, remittances, and development aid are from UNCTAD (2011), World Bank (2010*a*), and World Bank (2010*b*), respectively.

2 With the onset of the global financial crisis in 2007, FDI inflow into developed countries fell from a peak of US$1.31 trillion in 2007 to US$602 billion in 2009, whereas the more modest fall in developing countries occurred with a lag of one year, from a peak of US$658 billion in 2008 to US$511 billion in 2009. FDI flow increased rapidly from 1990 onward reaching the first peak of US$1.4 trillion in 2000. There was a dip in 2003, which is attributed to the drop in the share prices of high-technology companies (Helpman 2011). According to UNCTAD (2011), total FDI stock globally stands at a record US$19.1 trillion as of 2010.

Figure 2.1: FDI Inflow into Developing Countries



Source: UNCTAD World Investment Report 2011
Note 1: Nine large countries are Brazil, Russia, India, China, Mexico, Argentina, Indonesia, Turkey, and South Africa
Note 2: China includes Hong Kong & Macao

resolving investment disputes; and iii) time, procedures, and rules required to set up wholly foreign-owned subsidiaries. These FDI-specific indicators are the most comprehensive to date in terms of topics and countries, and they obviate the need to rely on proxy indicators for policy openness or the quality of institutions.

I also adopt a new methodological approach that corrects for two major biases prevalent in standard gravity models of FDI.[3] The first one arises when limiting the sample to only those countries that actually have an investment relationship with each other and excluding those that do not. This is a problem of country selection induced by zero bilateral flows. The second bias arises when firms are not differentiated by their ability to meet the fixed costs of investing abroad. This is the problem of firm heterogeneity. The two biases are linked when zero flows

3 Gravity models predict that bilateral flows such as trade, investment, and migration depend positively on economic pull such as Gross Domestic Product (GDP) of both home (exporter) and host (importer) countries, and negatively on frictions such as distance and policy barriers. For more on gravity models, see Bergeijk & Brakman (2010).

are caused by the fixed cost of investing abroad, and only the more productive firms meet such costs.

I build on the insight of the new trade literature that firms are heterogenous *within* industries in terms of productivity, size, use of inputs, and wages.[4] This translates into distinct decisions by firms (that co-exist within a narrowly-defined industry) on whether to export, or set up production bases in foreign countries, or just serve the domestic market (Greenaway & Kneller 2007; World Trade Organization 2008; Helpman 2011). When profits are a function of varying productivity and differing fixed costs, there is a natural sorting of firms, with the most productive self-selecting to undertake FDI (Helpman et al. 2004). The next tier serves the foreign market through export, and the least productive serve the domestic market only (Appendix B).[5]

The earlier generation of "new" trade models that integrated economies of scale and monopolistic competition achieved a breakthrough in understanding a new source of comparative advantage (Helpman 2011). However, they addressed neither heterogeneity nor country selection. In particular, the assumption of symmetry in firm size and productivity leading to a prediction that all firms export to all countries is not supported by evidence at the firm level.[6]

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4 The seminal paper of this new literature is Melitz (2003). He explains why only a fraction of firms export and why exporters are larger and more productive than non-exporters. Note, though, in the Melitz model, all firms pay the same wage. This model has generated a vast empirical literature on firm-level approach to international trade. It has also been applied to study the quantitative effects of simulated trade policy reforms (for a recent work, see Balistreri, Hillberry, and Rutherford, 2011).

5 This is supported by data. Helpman et al. (2004) show for US manufacturing firms across 52 sectors and 38 countries that multinational enterprises had 15 percent more labor productivity than exporters in 1994; exporters were 39 percent more productive than non-exporters. Girma et al. (2004), Girma et al. (2005), and Arnold & Hussinger (2005) all find significant productivity differences between firms that invest abroad and those that do not. Chen & Moore (2010) find in the case of French multinational firms that those with low productivity are less likely to invest in host countries with a small market size, high production costs, or low trade costs.

6 The new trade models of the 1980s successfully explained the phenomenon of intra-industry trade as caused by product differentiation on the part of firms operating under economies of scale. However, firms were assumed to be symmetric. All of them traded, but only the volume depended on trade costs. In other words, trade costs affected only the intensive margin (the volume of export per firm), not the decision of whether to export in the first place.

The paper proceeds as follows. Section 2.2 reviews the relevant literature on the determinants of FDI, highlighting the institutional drivers on which the paper builds. Section 2.3 sketches the theoretical derivation of a gravity-like model for FDI and its empirical extension. Section 2.4 introduces the data. Section 2.5 explains the econometric method used to incorporate firm heterogeneity and redress country selection bias. Section 2.6 presents the main results by comparing benchmark estimates with those obtained after correcting for biases. Section 2.7 uses alternative dependent and explanatory variables to check for robustness of results. The final section concludes.

2.2 RELATED LITERATURE

Three sets of literature address why and where firms choose to serve foreign markets by setting up foreign subsidiaries, and not through export or licensing arrangements. The first (and early) batch of literature emphasized that firms with ownership advantages have an incentive to become multi-national as they seek to internalize their proprietary assets (technology, brand, distributional efficiency) while exploiting location-specific advantages such as market size or access to factors of production. This is the Ownership-Location-Internalization (OLI) paradigm (Dunning 1977). OLI is seen as a "big-tent" paradigm as it has evolved since 1973 (when it was first introduced) to cover new ideas and practices in international business, including joint-ventures (alliance capitalism) and the internet.

Helpman (2011), however, views the OLI paradigm as too broad for the construction of a theory with sharp predictions. He highlights a more focused study of Internalization through three different lenses: the first is the transaction cost economics of firm boundaries; the second is the managerial incentives analysis of internalization; and the third is the property rights approach that builds on the theory of incomplete contracts. As the full rents for intangible assets cannot be appropriated through arrangements with third parties because of market failures, firms internalize the market transaction by establishing their own subsidiaries.[7]

The second set of literature attempts to account for the long-term determinants of FDI in a general equilibrium framework. Helpman (1984) proposed the vertical model of FDI where a firm fragments production of differentiated final goods at locations that are abundant in factors used intensively in a specific phase of production. The headquarters specialize in research and development, and production occurs at locations with competitive factor costs. This model predicts that FDI occurs between countries that are differently endowed.

Markusen (1984) proposed a horizontal model where firm-level scale economies drive FDI, which explains a large share of FDI across countries with similar factor endowments. Firms produce the same product at multiple locations with the aim of serving local markets directly rather than through exports. Brainard (1997) finds that such FDI, relative to exports, is increasing with higher trade costs, decreasing with investment barriers, and decreasing with scale economies at the plant level.[8]

Although the typology of FDI as either horizontal (market-seeking) or vertical (efficiency-seeking) is neat, most multinational firms today combine vertical and horizontal models of FDI. Markusen (1997) calls this a knowledge-capital model, in which activities are split across geography based on differing skill intensities. At the same time there are multiple production units of the same good taking advantage of non-rivalrous intra-firm assets.[9] Yeaple (2003) presents a model of why

7 Within subsidiaries, Lerner & Schoar (2005) find that investors in countries with weaker legal provisions for complex contract enforcement are more likely to insist on majority ownership and control of the board, even if such investments have lower valuation and returns. They contrast common and civil legal regimes in the degree to which complex contracts on cash flow and control can be assigned to different parties. Common law allows complex contract contingencies that allow investors to shift control rights depending on performance. Under civil law, control often has to be exercised through majority ownership. Lerner & Schoar (2005) show that this leads investors to opt for convertible preferred stock in common law countries, and common stock or debt in civil law countries.

8 In Brainard (1997), *all* firms make the same choices of either exporting or undertaking FDI. Contrary to the framework of Helpman et al. (2004) exports and FDI do not co-exist in the same industry.

9 The vertical model suggests that trade and FDI are complements; the horizontal model suggests they are substitutes; and, loosely, the knowledge-capital model suggests that trade and FDI tend to be substitutes for similar countries and complements for those with different factor proportion.

firms may choose "complex integration" of both horizontal and vertical motivations for FDI.

The third set of literature takes a partial equilibrium approach by looking at exogenous and policy factors that affect the magnitude of FDI, not whether FDI takes place in the first place or not. It explores the role of exchange rates, trade protection, taxes, agglomeration, and the quality of institutions, among others, as driving the magnitude of FDI (Blonigen 2005).

The empirical part of this paper, which is in the partial equilibrium tradition, focuses on the institutional determinants of FDI. I am mainly concerned with poor economic institutions that constrain human behavior by distorting incentives. This includes weak rule of law, limits on private ownership, expropriation risks, lack of enforcement of contracts, poor provision of public goods, over-regulation and high costs of doing business whose cumulative effect is to deter entrepreneurship. Poor institutions also contribute to an indifferent quality of public goods that discourage investment, domestic or foreign. The challenge in this literature has been to find appropriate measures of the quality of institutions.[10]

One of the first papers to explore the effects of policy and institutional quality on FDI is Wheeler & Mody (1992). They consider a list of 13 variables to represent institutional quality ("risk"), and nine variables to represent openness, and show both risk and openness to be insignificant determinants of FDI. Wei (2000) and Wei & Shleifer (2000) find that corruption and tax rates on multinational firms affect inward FDI negatively. While firms may voluntarily choose not to invest in highly corrupt countries, all else being equal, Hines (1995) finds that legislation at source can be a deterrent: the passage of the Foreign Corrupt Practices Act of 1977 in the United States led to a decline in American investment in bribe-prone countries.

In the international business literature, Dunning (1993) summarized four motives for FDI: market seeking, natural resource seeking, efficiency seeking, and strategic asset seeking.

10 In economics, the primary focus is on market-creating institutions such as the protection of private property and the rule of law (Rodrik et al. 2002). *The Economist* argues that there is no consensus on what the rule of law constitutes (The Economist 2008).

Stein & Daude (2002) and Daude & Stein (2007) use a broad set of "institutional" variables to find that regulatory burden is an important determinant of FDI location. They draw on a wide range of sources: i) World Governance Indicators (WGI) developed by Kaufmann et al. (2010);[11] ii) International Country Risk Guide (ICRG) variables on the risk of repudiation of contract, risk of expropriation, corruption, rule of law, and bureaucratic quality; iii) La Porta et al. (1999)'s index of shareholder rights, and iv) World Business Environment Surveys on taxes and regulations, policy instability, and corruption.

Bénassy-Quéré et al. (2007) use 2001 survey data from the French Finance Ministry to find that effective bureaucracy and low corruption, among others, attract FDI. Kinda (2010) brings to bear firm-level data to find that institutional problems, together with poor infrastructure and financing constraints discourage FDI in a sample of 77 developing countries. Mottaleb & Kalirajan (2010) use panel data from 68 low-income and lower-middle income developing countries to show that open countries that rely on trade, have large GDP, high growth rate and are business-friendly tend to be more successful in attracting FDI.

Alfaro et al. (2008) explain the "Lucas Paradox" of inadequate capital flows from rich to poor countries. Despite rates of return being higher in countries where capital is scarce, they argue that poor countries do not receive investment from abroad because of institutional weaknesses. But there are exceptions. Fan et al. (2009) attribute record inflow of FDI into China in recent decades, in spite of the indifferent quality of the country's institutions, to its stewardship of sustained economic growth.

While this literature confirms the salience of specific institutional variables, it suffers from limitations relating to model mis-specification and variable mismeasurement. The studies mentioned above do not address the problem of sample selection that arises when the pairing of FDI-sending and receiving countries does not occur randomly. They do not incorporate firm heterogeneity in a cross-national

11 The data set is World Bank (2010c).

framework. And they associate FDI inflow with *general* quality of institutions, not quality that is *specific* to FDI.[12]

Bergstrand and Egger (2009) summarize the vast literature on the theoretical and empirical foundations of gravity models of trade and FDI. I am, however, not aware of any paper that addresses the three problems mentioned above in a study of the institutional determinants of bilateral FDI. As already mentioned, I use new data on regulations that are specific to FDI and the new empirical methodology that has been applied to export flows by Helpman et al. (2008).

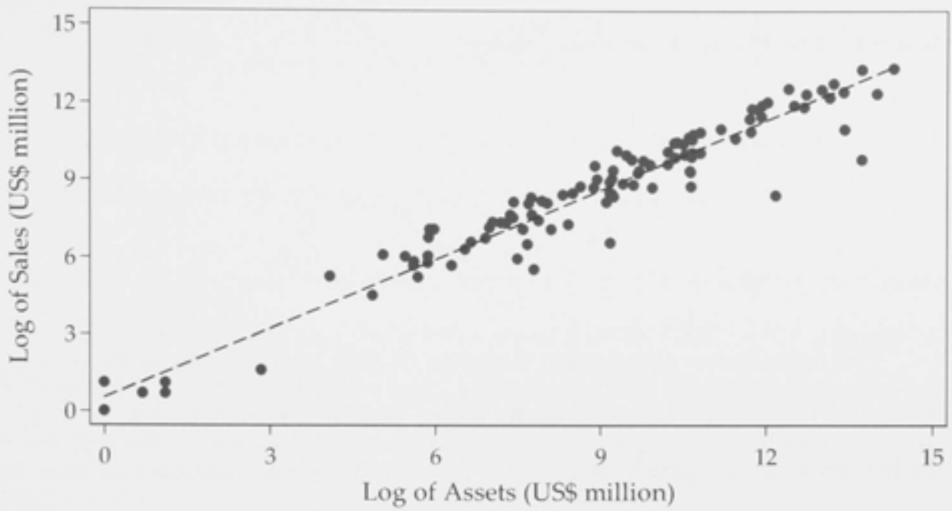
Central to the paper's methodology is the exploitation of the presence of zero flows between trading partners to estimate productivity cut-offs of firms that export abroad profitably. In trade, zero flows inferred from databases like the United Nations Commodity Trade Statistics Database (COMTRADE) are flawed because unreported figures are conflated with confirmed zeros. Baranga (2009) estimates that roughly 20 percent of the sample used by Helpman et al. (2008) has been misclassified. In contrast, the database – OECD (2011) – that I use for FDI clearly distinguishes between missing and zero flows between investment partners. This greatly enhances the appropriateness of the use of the new methodology in this paper.

2.3 MODEL

The model is adapted from the gravity-type trade model of Helpman et al. (2008) and Anderson & Van Wincoop (2003). The derivation of the model – for FDI – is detailed in Appendix A, and summarized next. A representative consumer prefers variety (v) and maximizes a Constant Elasticity of Substitution (CES) utility function $U = [\int x(v)^{\rho} dv]^{1/\rho}$ subject to aggregate expenditure (E). All varieties have a constant demand elasticity, $\sigma = \frac{1}{1-\rho} > 1$. A firm in country i produces one unit

12 One exception is Wei & Shleifer (2000), but they acknowledge their coding of incentives and restrictions on FDI is coarse and limited to fewer than 50 countries.

Figure 2.2: Assets and Sales by US Affiliates, 2008



Source: US Bureau of Economic Analysis (www.bea.gov)
Note 1: Correlation coefficient is 0.97
Note 2: Affiliates are majority-owned US companies

of output with a cost-minimizing combination of inputs $(c_i a)$ where a indexes firm-specific productivity and measures the number of bundles of the country's inputs used per unit of output; c_i is the cost of the bundle which is uniform across country i. Firms maximize profit, and do not interact strategically with each other.

Multinational firms from home country i sell goods through subsidiaries and face price and demand in host country j. Serving the foreign market through FDI (instead of exports) reduces transport costs, but adds non-trivial coordination and transaction costs represented by τ_{ij}^f, in addition to the fixed cost (f_{ij}^f) of setting up a new plant which is assumed to exceed the fixed cost of exporting (f_{ij}^e). (Serving country j through exports instead would involve exogenous trade and transport costs, τ_{ij}^e, but lower fixed cost. It is assumed that $\tau_{ij}^e > \tau_{ij}^f$ and $f_{ij}^f > f_{ij}^e$.)

There is a wedge between the price of each variety in country j and country i represented by bilateral mark-up and transaction costs, so $p_j = \frac{\tau_{ij}^f c_j a}{\rho}$. Firm productivity is assumed to be Pareto distributed with support $[a_L, a_H]$ and only firms with productivity a_{ij} such that $a_L < a_{ij} < a_H$ undertake FDI without incurring a loss. The profit condition (revenue over demand elasticity net of fixed costs) yields the cut-off productivity level as follows:

$$a_{ij} \quad = \quad \left[\frac{Y_j(1-\rho)}{c_i f^f_{ij}}\right]^{\frac{1}{\sigma-1}} \frac{\rho P_j}{\tau^f_{ij} c_j} \tag{2.1}$$

The cumulative distribution function of firm productivity is $\Pr(a < a_{ij}) \equiv G(a_{ij}) = \frac{(a_{ij})^k - {a_L}^k}{{a_H}^k - {a_L}^k}$ where k is the shape parameter such that $k > \sigma - 1$. The distribution of firm productivity $G(a)$ is common across countries ex ante, but ex post $G(a_{ij})$ is the distribution of a in country i conditional on the firm investing in country j.

Total FDI[13] from i to j is $\int_{a_L}^{a_{ij}} p_j x_j N_i dG(a)$ where $G(a_{ij})$ is multiplied by the number of firms N_i which proxies for country i's economic size. Investment can increase on either the extensive or the intensive margin. If demand or policy costs in country j are constant, the only way investment can increase is through an exogenous productivity shock in country i allowing an increased fraction of firms to invest abroad (F_{ij}). If, on the other hand, productivity is constant, investment can increase only with an increase in the GDP (Y_j) or a fall in the fixed and variable costs in host country j.

Substituting for p_j and x_j,

$$FDI_{ij} \quad = \quad \left[\frac{\tau^f_{ij} c_j}{\rho P_j}\right]^{1-\sigma} Y_j N_i F_{ij} \tag{2.2}$$

13 Technically, in this model, FDI should be measured by sales of foreign-owned subsidiaries, but because of the lack of detailed data, it is proxied by FDI stock. Affiliate sales and FDI stock are highly correlated. The correlation between total assets (that is, FDI stock plus liabilities) and sales of US majority-owned foreign subsidiaries across 113 countries in 2008 was 0.83. The correlation coefficient of the values of assets and sales, expressed in natural logarithm, is 0.97 (Figure 2.2).

As shown in Appendix A:

$$F_{ij} = \frac{k a_L^{k-\sigma+1}}{(k-\sigma+1)(a_H{}^k - a_L{}^k)} \left\{ \left[\frac{a_{ij}}{a_L} \right]^{k-\sigma+1} - 1 \right\} \tag{2.3}$$

The first component is common across all countries, but the second term in brackets reflects the country-specific fraction of firms that invests abroad.

Equation 2.2 can now be estimated empirically in its log-linear form in equation 2.4. The main host country (j) variables are as follows: GDP ($\ln Y_j$), aggregated CES Price Index ($\ln P_j$), and factor costs relevant for FDI ($\ln c_j$). Factor costs capture per unit cost of production in country j such as wages, and all policy-related costs.

$$\begin{aligned} fdi_{ij} &= (\sigma-1)\ln\rho + (\sigma-1)\ln P_j + (1-\sigma)\ln c_j + (1-\sigma)\ln\tau_{ij} \\ &+ \ln N_i + \ln Y_j + \nu_{ij} \end{aligned} \tag{2.4}$$

The purpose of this paper is to examine how country-specific FDI-relevant policies and institutions affect the attraction of FDI in a single cross-section, so host countries are not assigned dummies. I approximate c_j by quantified FDI-specific regulations, GDP per capita, tariffs, and education levels. Variables with subscript i are captured by a fixed effect for the FDI source country.

Bilateral variables specific to country pairs such as distance, colonial tie, contiguity and shared ethnic language can either hinder or facilitate bilateral transactions. Such costs have an observed component d_{ij} and an unobserved component e_{ij}.[14] An important additional regressor is w_{ij}. It captures the ij component of F_{ij}, the index for extensive margin. It is a monotonic function of the productivity cut-off, a_{ij}, and is correlated with d_{ij} because many of the same variables that determine FDI flow determine the extensive margin. Although w_{ij} is unobserved, the cut-off condition in equation 2.1 implies that it can be estimated by

14 Bilateral transaction costs $\tau_{ij}^{1-\sigma}$ are parametrized as $D_{ij}^{\gamma} e^{-u_{ij}}$; $u_{ij} \sim N(0, \sigma_u^2)$

the conditional probability of a positive investment flow from a probit (first-stage) estimation. Omission of w_{ij} would create a heterogeneity bias.

The second bias arises because of the correlation between e_{ij} and the included regressors in equation 2.4 as country pairs with zero investment flows are excluded from the sample. Only after controlling for these heterogeneity and sample selection biases can coefficients be rendered more accurate. The discussion so far permits the specification of the benchmark regression (without correcting for biases) in equation 2.5.

$$\begin{aligned} \mathbf{log(FDI_{ij})} &= \mathbf{X_{ij}a + b_1 log(Openness)_j + b_2 log(Arbitration)_j + b_3 log(Procedures)_j} \\ &+ \mathbf{b_4(Quality\ of\ Institutions)_j + b_5 log(GDP)_j + b_6 log(GDP\ per\ capita)_j} \\ &+ \mathbf{b_7 log(Remoteness)_j + b_8 log(Weighted\ Tariff)_j + b_9 log(Schooling)_j} \\ &+ \mathbf{\sum_i (Source\ Dummy)_i * D_i + e_{ij}} \end{aligned} \tag{2.5}$$

Full definition of all the explanatory variables in the above equation is given in Table 2.13. The dependent variable is the positive stock of bilateral FDI from country i to country j, averaged between 2007 and 2008.[15] Among the "gravity" explanatory variables, Vector **X** consists of distance, and dummies for whether two countries share a border, an ethnic language, or have had a colonial relationship. The benchmark regression also includes a dummy for whether the two countries have signed a Bilateral Investment Treaty (BIT) to assure reciprocal protection of foreign investment in each other's territory.[16] This variable later serves as a valid

15 UNCTAD (2011) defines FDI stock as the value of the share of capital and reserves (including retained profits) attributable to the parent enterprise (total assets minus total liabilities), plus the net indebtedness of the associate or subsidiary to the parent firm. FDI flows plummeted in 2008-09 because of the global financial crisis. I therefore disregard FDI values after 2008.

16 Most BITs contain broad commitments to protect investments by investors of one state ("the investor") in the territory of the other state ("the host state"), ranging from assurances of fair, equitable, and non-discriminatory treatment to undertakings to observe investment contracts and other investment-related obligations. As Malik (2006) explains, these protections are accompanied by a powerful international arbitration mechanism that allows investors to bring claims directly against the host state alleging violations of these protections under international law. The ability of investors to enforce their rights directly against a state without the need of an agreement between the investor

exclusion restriction in a two-step Heckman procedure to control for selection bias.

The "policy" explanatory variables are openness to FDI, start-up procedures for FDI, and FDI-related arbitration regime. A simple theory on how they restrain FDI is illustrated in Figure 2.3. In Panel A, hurdles to start-up a subsidiary or resolve disputes act as cost-escalating measures that reduce the supply of the good or service (from Q to Q') as they raise the real resource cost to providers at every price level. If the supply of foreign providers is choked off at Q' (like a quota) there is a rent-creating effect in favor of incumbent firms.[17]

Panel B of Figure 2.3 shows another effect of restricting foreign capital from Holmes & Hardin (2000). If there is no restriction at the world rental rate (R^W) foreign capital meets the demand between Q' and Q freely. With maximum ownership restriction of, say, 30 percent, every unit of foreign capital is matched by two units of domestic capital which needs a higher rate of return to be diverted into the sector. This leads to a derived demand (D') for domestic capital. The effect is that the rate of return is higher and less capital is used overall than in a state where there is no restriction on ownership of equity. The "tariff-equivalent" of the investment barrier is the difference between the return in the restricted sector and the return in the world market $(R' - R^W)$.

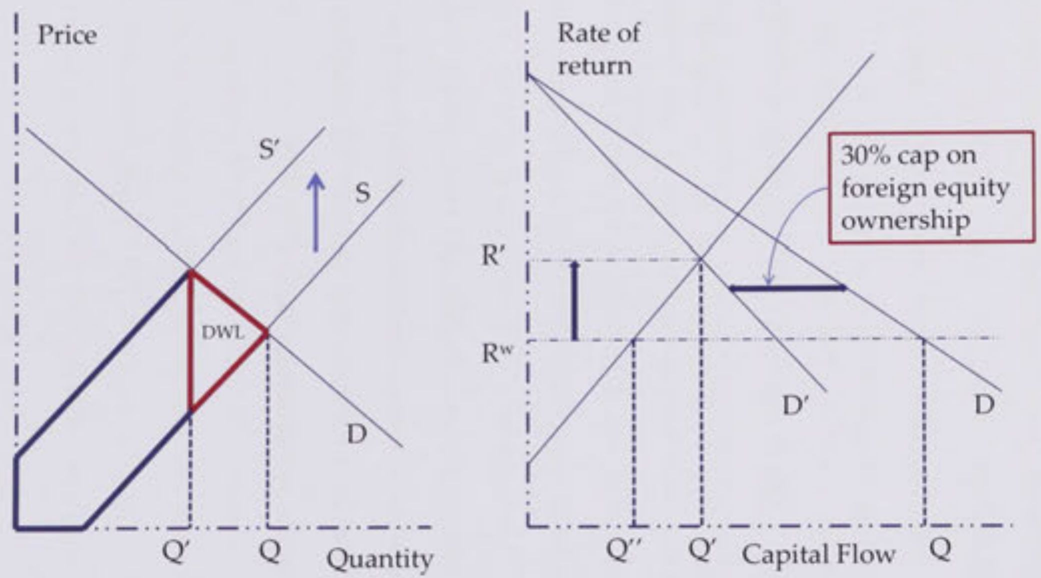
and state or the involvement of their own state is seen as one of the most far reaching innovations of BITs.

17 Dee (2003) explains this in terms of liberalization leading to a "triangle gain" from allocative efficiency as the tax-equivalence posed by restrictions to entry are removed, and a "rectangle gain" from productivity enhancement when the high cost of starting or running a business is reduced in a manner that saves real resources to be used elsewhere.

Figure 2.3: Illustration of the Impact of Restricting FDI

A. Effects of procedural restrictions

B. Effects of equity restrictions



Source: Holmes & Hardin (2000)

I posit that the three indicators of openness, procedures, and arbitration capture a defining thought process of a typical foreign investor. First, the investor is concerned about whether the host country permits foreigners to set up a business in a specific sector; if it does, how much equity can foreigners own? Second, if entry is permitted, what additional hurdles (legal and bureaucratic) does the country pose through regulations and how costly are they? Third, after the operation commences, and if commercial disputes arise, can they be resolved with enforceable outcomes in a reliable manner? The first issue is about FDI-specific openness; the second and third issues represent the quality of FDI-specific institutions.

FDI Openness is measured by computing the average of the percentage of equity that foreign investors can own in firms across 11 sectors (more in the next section). FDI Procedures measure the number of legal steps required before and after incorporation to start a wholly foreign-owned business. I construct the FDI Arbitration index by averaging indicators measuring i) the Ease of Arbitration Process and ii) the Extent of Judicial Assistance in resolving commercial disputes from the IAB data set. The Ease of Arbitration Process assesses whether there are restrictions on what the conflicting parties can or cannot do to resolve their dispute. The Extent of Judicial Assistance measures the role of domestic courts in assisting the process of arbitration and enforcing awards.

To control for the *general* quality of institutions, I compute a composite indicator of five WGI developed by Kaufmann et al. (2010) with weights derived from Principal Components Analysis (PCA). The WGI variables are: i) the rule of law; ii) control of corruption; iii) regulatory quality; iv) political stability; and v) governmental effectiveness. Of the six WGI indicators, the one that I exclude is "voice and accountability" which is argued to capture citizens' participation in selecting their government, as well as freedom of expression, freedom of association, and free media. I find this to be a less relevant determinant of FDI.[18]

18 I concur with Thomas (2006) who argues that the concept of voice first articulated by Hirschman (1970) is not synonymous with accountability, freedom to select government, or other political freedoms. Nor is there a well-documented relationship between them. Overall, in terms of coverage of countries and topics, the WGI indicators are perhaps the most authoritative and widely used to

The control for a general quality of institutions as measured by the WGI variables is important because I want to see whether FDI-specific regulations matter for FDI *over* and *beyond* the general quality of institutions. In other words, after controlling for the general quality of institutions, do FDI-specific provisions add any value?

Market size of the host country, proxied by GDP, is one of the most important determinants of horizontal FDI. Motives for vertical FDI are captured by GDP per capita (which proxies for average wage and the quality of infrastructure). Tariff rates are measured by the weighted average of applied tariffs on manufactured imports. The effect of high tariffs on FDI, a priori, is ambiguous: it may encourage tariff-jumping horizontal FDI, but discourage vertical FDI that relies on repeated flows of parts and components across borders. The general skill level in the country is assessed by the average number of years of schooling undertaken by adults aged 25 and over. Other determinants of FDI that are not included as regressors are subsumed under the unobserved term, e. The description, source, and summary statistics of the variables are in Tables 2.13 and 2.14.

2.4 DATA

I average outward FDI position (stock) in US dollars for 2007 and 2008 from 30 OECD countries into 87 OECD and non-OECD countries belonging to the IAB sample (Table 2.16). The years 2007 and 2008 represent the latest and most stable number of observations in the OECD's FDI database, prior to the plunge in cross-border flows in 2009 because of the global financial crisis. Two-year averages are used to smooth out annual fluctuations. For robustness, I also use un-averaged annual data for 2006, 2007, and 2008. Bilateral FDI from each source country, instead of aggregate FDI from all source countries, is used to cast the relationship in

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assess the quality of institutions across countries over time. They are imperfect because they are a quantitative aggregation of perceptions (subjective data). For a summary of criticisms of these indicators and the response from the authors, see Kaufmann et al. (2007).

a gravity framework yielding a richer set of observations than would be the case for a cross-country regression with aggregate FDI. Source countries include only members of the OECD because of data constraints; however, they have historically accounted for the majority of global FDI outflows.[19]

The choice of FDI stock, rather than FDI flow, as the dependent variable needs elaboration. The model in Melitz (2003) which inspired Helpman et al. (2008) is inherently cross-section because it assumes steady state productivity levels for each year, and does not predict how firm productivity changes year to year. Because I do not have a variable time dimension in my econometric model, the effects of explanatory regressors are on an equilibrium level of FDI. This is better reflected by FDI stock because it is far less volatile on an annual basis than FDI flows. Importantly, the extensive margin of FDI measured by whether multinational firms from country i operate in country j can only be estimated by FDI stock, not flows.

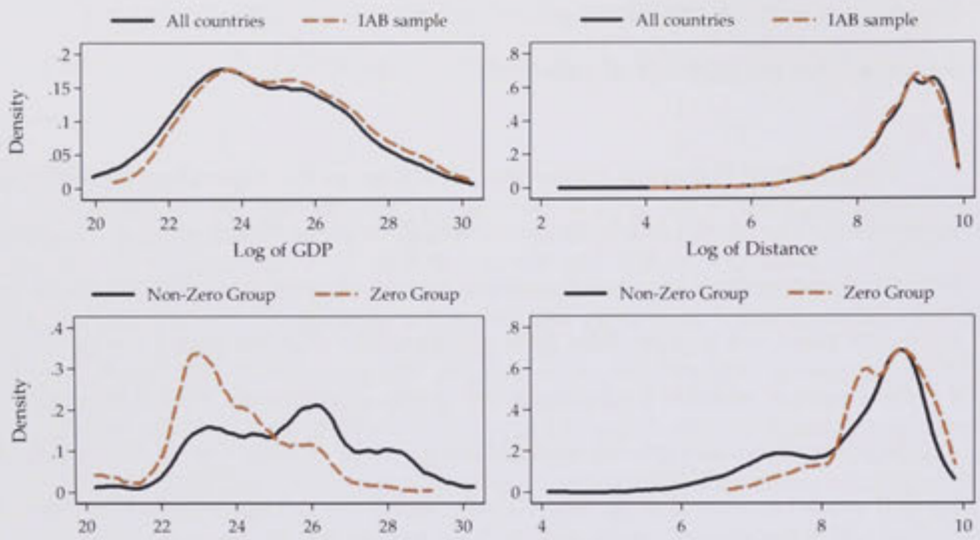
For the main explanatory variables, I use the new IAB indicators of FDI regulation across 87 economies, prepared by the World Bank Group in 2010. With 21 countries from Sub-Saharan Africa, 20 from Eastern Europe and Central Asia, 14 from Latin America and Caribbean, 10 from East Asia and Pacific, five from South Asia, and five from the Middle East and North Africa, this sample of 87 countries can be considered random, and a fair representation of the actual world. In 2007-08, they constituted 87.1 percent of global population and 77.9 percent of global output (Table 2.15). The sample includes 15 high-income OECD countries.

As shown in Figure 2.4, in terms of market size, the mean and standard deviation of the sample of all countries[20] in the world and the subsample of 87 IAB countries are almost identical. However, within the IAB sample the distribution of the subgroup with zero FDI observations is remarkably different from the sub-

19 FDI outflows from non-OECD countries are increasing. For example, in 2003, 12.3 percent of total FDI inflow into the 10 member countries of the Association of Southeast Asian Nations (ASEAN) was from China, India, and other ASEAN countries; by 2008, the corresponding share had reached 24.8 percent (ASEAN 2010).

20 Excludes countries with total population of less than one million in 2008.

Figure 2.4: Randomness of Country Samples



Source: WDI & CEPII

group with non-zero observations. The sample selection bias is, therefore, likely to be more prominent within the IAB sample.

The 23 IAB indicators measure, among others, openness to FDI through equity ownership permitted in 11 sectors (11 indicators); time, procedures and regulations for starting a foreign business (three indicators); arbitrating commercial disputes (three indicators); and accessing industrial land (6 indicators). The data are compiled from detailed surveys filled out by over 2350 local experts from leading law and accounting firms, chambers of commerce, and investment promotion agencies. Collected during the period 2006-08, these indicators reflect regulations that prevailed before 2006 in each of the 87 countries.

In terms of the coverage of subjects, sectors and countries, this data set on FDI regulations is the most comprehensive to date. It comprises both de jure indicators measuring laws and regulations on paper, and de facto indicators that measure the implementation of those laws. To the extent possible, I create sub-indices of primarily de facto indicators of FDI Arbitration and FDI Procedures to use in the empirical estimation. On FDI Openness, the indicators are only de jure, and these tend to do less justice to countries that are open to foreign investment in practice but have not enshrined it in written law. I expand on the main explanatory variables below.

2.4.1 *Investing Across Sectors*

Restriction on equity ownership across sectors is one of the most important indicators of a country's policy attitude towards foreign investment. The index of FDI openness is created for 86 countries[21] by averaging the equity ownership permitted for foreign companies across 33 subsectors. These measure statutory (not de facto) restrictions to the ownership of equity by foreigners in new (greenfield) investment, and investment in existing firms through mergers and acquisitions. Sixty-six data points for each country are aggregated first into 33 subsectors, and then into 11 industries (eight of which are services, two are resources/primary, and one manufacturing). The final index shows on a scale of 0 to 100 the overall openness in a given country to ownership of firms by foreign investors (0 being least open).

2.4.2 *Arbitrating Commercial Disputes*

Most foreign companies prefer resolving disputes through arbitration over lengthy litigation in local courts. The indicators assess the strength of legal frameworks for alternative dispute resolution by combining the Ease of Arbitration Process and the Extent of Judicial Assistance indices to represent the quality of FDI-specific institutions. This index directly deals with how foreign investors prefer to resolve contractual or commercial disputes. It is also strongly correlated with the rule of law, government effectiveness, corruption, and regulatory quality pillars of the

21 Excluding Papua New Guinea for which equity data could not be confirmed.

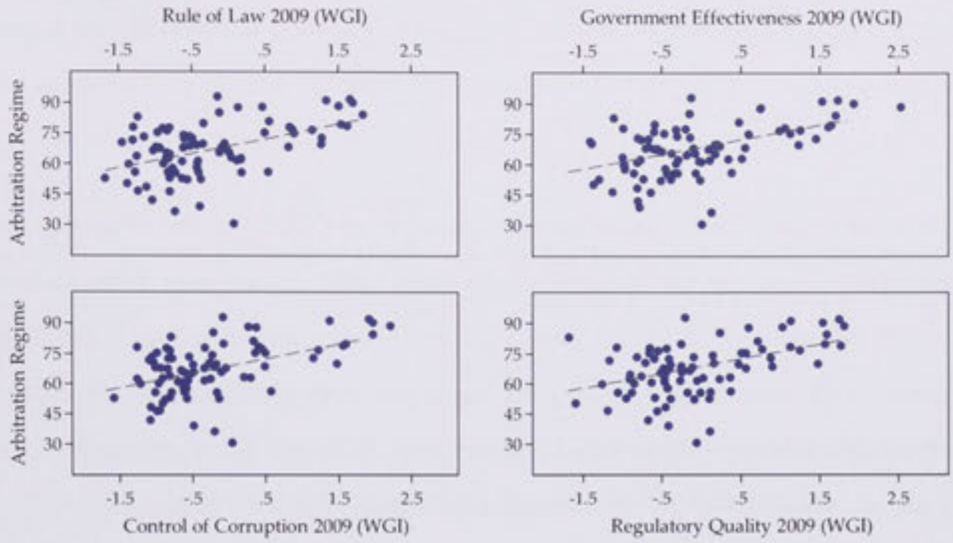
Worldwide Governance Indicators that summarize a country's institutional regime in general (Figure 2.5).[22]

Specifically, the index on the Ease of Arbitration Process scores, among others, best practice provisions for party autonomy and tribunal integrity. Autonomy assesses whether the laws allow parties to choose arbitrators or arbitral institutions, the language of proceedings, and whether foreign counsels can represent investors. Tribunal integrity measures whether there exist provisions to ensure that arbitrators remain independent and impartial and whether the proceedings remain confidential. The other index on judicial assistance evaluates whether local courts follow a "pro-arbitration" policy, whether tribunals decide the jurisdiction of disputes and whether the courts assist tribunals by requiring the appearance of witnesses and production of evidence.

What are the bases for these indicators? Investors need to be assured that their investments will not be unjustly expropriated and that in instances of disputes, there is a predictable course for resolution. An effective arbitration regime for FDI mitigates risk by providing legal security to investors (including assurance of contract enforcement rights, due process, and access to justice). It gives parties autonomy to create systems tailored to their disputes. According to World Bank Group (2010), countries that score well on these indicators have a strong arbitration legal framework, receive support from local courts for arbitration proceedings and efficient enforcement, adhere to international conventions, and provide autonomy to parties seeking to resolve their commercial disputes.

22 The scatter plots in Figure 2.5 exclude outliers – Afghanistan and the Solomon Islands – that score zero on the Ease of Arbitration Process index and the Extent of Judicial Assistance index. Serbia is excluded from the WGI data set. This leaves 84 country observations.

Figure 2.5: General Quality of Institutions and Arbitration Regimes



Source: WGI & IAB

2.4.3 *Starting a Foreign Business*

Starting a Foreign Business indicators record the time, procedures, and regulations involved in establishing a local subsidiary of a foreign limited liability company. Here, I use the number of procedures required to establish a foreign business. This resembles a cost that affects the decision about whether and how much a firm invests in a foreign country. The steps include both pre- and post-incorporation procedures with which foreign businesses are officially required to comply. According to World Bank Group (2010), countries that score well on the Starting a Foreign Business indicators have simple and transparent establishment processes that abolish unnecessary steps (which create opportunities for rent-seeking). High scorers also treat foreign and domestic investors equally, and differences in treatment vary only by company size, legal form or commercial activity, not the nationality of shareholders. Tables 2.19 to 2.21 describe how indicators of FDI-specific regulations are constructed in the IAB data set. I separately construct composite country scores for the quality of selected FDI regulations in Table 2.22.[23]

2.4.4 *Bilateral Investment Treaty*

Data on bilateral investment treaties between 30 OECD source countries and 87 IAB host countries are collected from UNCTAD's Investment Instruments Online.[24] Bilateral Investment Treaties (BITs) are agreements between countries for the reciprocal encouragement, promotion, and protection of investments in their territories. Like preferential trade agreements, BITs, too, have proliferated dramatically in recent decades from around 400 in 1990 to over 2,500 at present.

2.4.5 *Gravity and Other Variables*

The gravity variables – distance, past colonial relationship, contiguity, and shared languages – are obtained from CEPII (2010). Economic variables – GDP, GDP per capita, average (weighted) applied tariff on manufactured imports – are from the World Development Indicators (WDI) database (World Bank 2010*b*). Mean years of schooling are from Barro & Lee (2010), as intrapolated in UNDP (2010). These explanatory variables available annually are averaged over the preceding five years, that is, 2002 to 2006 to minimize the possibility of simultaneity. I compute the remoteness index as the sum of all bilateral distances between a country and all its partners, weighted by the share of the partner's GDP in total world output.

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23 The Investing Across Sectors score (1) averages the maximum percentage of equity permitted for foreign ownership in the 11 sectors mentioned in Table 2.19. The Ease of Process Index (2) and the Ease of Judicial Assistance Index (3) are obtained by normalizing the country score for those indices using the min-max rule: the score for a country is subtracted from the best-performing country, divided by the difference in scores between the best and worst-performing countries. The number is then multiplied by 100. Higher the score, better is the regime in place for resolving commercial disputes. The score for the Number of Procedures (4) is also obtained by normalizing the country score using the min-max rule. However, the final score is multiplied by, and subtracted from, 100. Higher the score, the fewer the number of pre- and post-incorporation procedural steps formally required to establish a wholly foreign-owned subsidiary.

24 See UNCTAD (2010).

With 30 source countries and 87 host countries, there are 2610 potential observations. Gravity-related information is not available for three host countries (Kosovo, Montenegro, and Serbia). Because 15 OECD countries also appear in the IAB sample of FDI recipients, another 15 observations are lost, reducing the number of observations to 2505. If FDI stock data are missing for the years 2007-08, but they were reported for the period 2002-06, I recode the missing data points as zero. This affects 82 country pairs; 641 data points are deemed missing and dropped along with 29 negative values for FDI stock (divestitures).

Of the remaining 1835 observations, there are 724 observations that are confirmed to be zeros.[25] Not all of the 87 countries in the IAB sample have values for all explanatory variables. Papua New Guinea has no data on FDI Openness; Sierra Leone, Haiti, and Liberia do not have data on tariffs. Further, four OECD source countries (Italy, Spain, Japan, and Switzerland) do not have zero FDI in any of the remaining IAB countries (after missing values are dropped). This poses a problem for the two-step econometric methodology employed in this paper; those source countries are therefore dropped. Belgium and Mexico do not report any data for FDI stock for the years under consideration. All these reduce the number of observations used in the estimation of the main regressions to 1578 bilateral FDI stock values between 24 OECD source countries and 80 IAB host countries, including 666 observations of confirmed bilateral flows with the value of zero.

2.5 ESTIMATION METHOD

The estimation method proceeds in five stages. First, I estimate the log-linear gravity equation 2.5 using the Ordinary Least Squares (OLS) method, without correcting for biases. Second, I correct for the selection bias in two steps. A probit model predicts the probability, $\hat{p}_{ij}$, of countries having a positive FDI relationship conditional on explanatory variables that are used to estimate equation 2.5. I use the binary

25 As already explained, one positive aspect of OECD's bilateral FDI statistics is that they clearly distinguish between values that are missing and values that are confirmed to be zeros. In trade statistics, this is often not done, leading researchers to erroneously treat unreported (missing) data as zero.

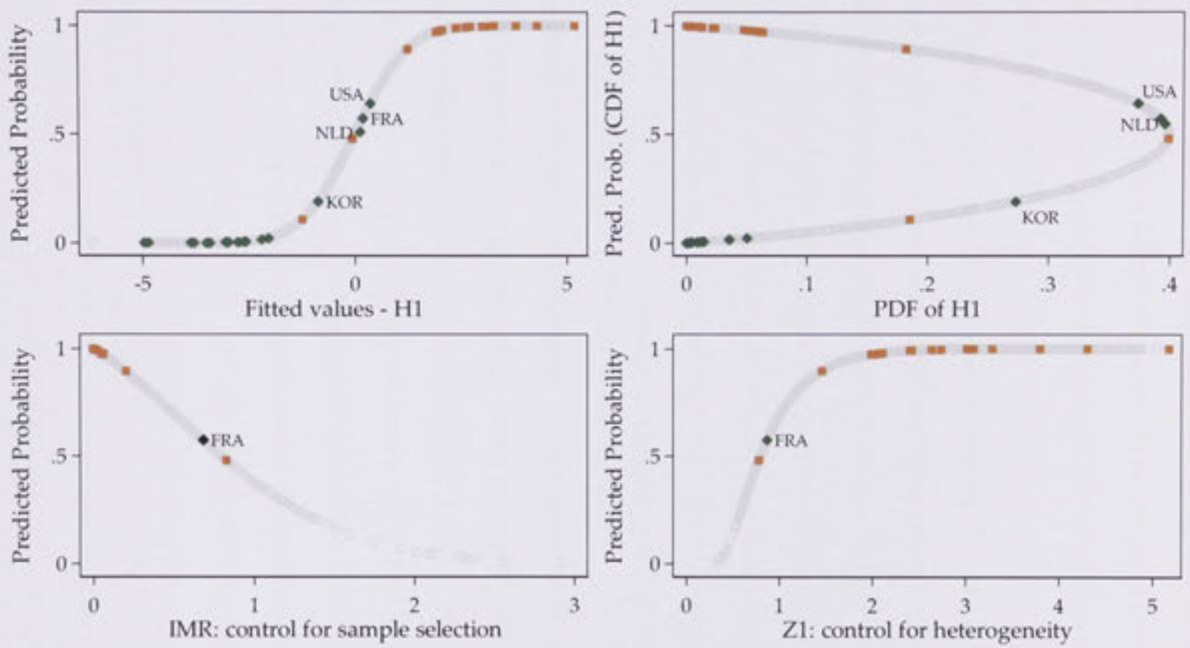
BIT variable as a valid exclusion restriction. This permits the computation of the inverse Mills ratio ($\bar{\bar{\eta}}_{ij}$) for inclusion as an additional regressor in the second step to control for sample selection.

In Figure 2.6, the top-left graph shows predicted probability of OECD countries i investing in country j on the y-axis. The x-axis plots the normalized fitted values of the latent variable that affects FDI participation. The top right graph plots the cumulative distribution function (CDF) of the unit normal (predicted probability) on the y-axis against the PDF of the fitted value of the latent variable on the x-axis. The ratio (PDF/CDF) obtained is the inverse Mills ratio ($\bar{\bar{\eta}}$), as depicted on the x-axis of the bottom-left graph. The inverse Mills ratio controls for the fact that there are countries in the sample with low predicted probability (and large errors).

Selection bias occurs in two ways: i) when only countries with "high" values of observed variables are included in a non-random sample; and ii) when countries with "low" values of observed explanatory variables are also in the sample with large, unobserved error terms. It is (ii) that is a more serious problem because the correlation between the error terms and the observed variables biases the coefficients. For example, the Sub-Saharan economy, Mali, in 2007-08 had an FDI relationship only with France (among OECD members). Conditional on observed explanatory variables, the predicted probability of a positive FDI relationship between Mali and France is 0.57. If France had not been a former colonial power, the predicted probability would have been 0.36. The second scenario would then have led to a higher inverse Mills ratio.[26]

26 Note that probit also predicts a moderately high probability of two other source countries – United States (US) and the Netherlands – having a direct investment relationship with Mali even though in reality they do not invest there. This is because the two countries have invested in similar-sized African economies: the Netherlands in Burkina Faso and Rwanda, and the US in Rwanda. The Netherlands also has a BIT signed with Burkina Faso and the US has one with Rwanda.

Figure 2.6: Correcting for Country and Firm Selection Biases



Source: Regressions by author using data from OECD (2011)
Note 1: Diamond-shaped dots are FDI to Mali and squared dots are FDI to Spain
Note 2: Other (gray) dots represent other country pairs

Third, I take into account firm heterogeneity by incorporating controls derived from predicted probabilities which are first normalized, $\hat{z}_{ij} = \Phi^{-1}(\hat{p}_{ij})$. Because the latent variable that determines whether or not two countries have an FDI relationship is linked to the productivity level of the marginal firm, it can be used to control for the unobserved heterogeneity term in equation 2.4. If firm productivity is Pareto-distributed, this has the form $max\left\{Z_{ij}^{\delta} - 1, 0\right\}$ where $\delta = \frac{k-\sigma+1}{\sigma-1}$. The latent variable is unobserved, but its log value is estimated by the inverse of the unit normal of predicted probabilities, $\hat{z}_{ij} = \Phi^{-1}(\hat{p}_{ij})$. Given that $E\left[z_{ij}|FDI_{ij} = 1\right] = E\left[z_{ij}\right] + E\left[\eta_{ij}|FDI_{ij} = 1\right]$, Helpman et al. (2008) show that control for unobserved firm heterogeneity can be estimated by $\hat{\hat{z}}_{ij} = \hat{z}_{ij} + \bar{\bar{\eta}}_{ij}$. In other words, the index $\hat{\hat{z}}_{ij}$, shown on the bottom right graph of Figure 2.6 as Z1, controls for the effect of investment restrictions on the proportion of firms able to profitably invest abroad. If the host (and bilateral) country characteristics pose low barriers (c_j, τ_{ij}, f_{ij}) and there is high demand in (Y_j), for a given level of productivity (a_{ij}) a greater fraction of firms will find it profitable to invest.

Fourth, the final regression is estimated both by Non-linear Least Squares (NLS) and OLS. The former is a parametric estimation that requires firm productivity to be Pareto-distributed. Helpman et al. (2008) suggest that estimates can also be obtained from OLS if the extensive margin is represented by a polynomial of $\hat{\hat{z}}_{ij}$.[27] Because the OLS coefficients have the same sign and are very close in magnitude to the NLS estimates, I opt for the simpler OLS method to report most of the robustness results in subsequent sections.

Fifth, the two biases that are corrected in the preceding step are disentangled to assess the relative dominance of each. The purpose is to find whether the failure to control for firm heterogeneity biases the coefficients more than the failure to control for sample selection bias arising from zero investment flows between numerous country pairs.

27 Note that $\bar{\bar{\eta}} = \frac{\phi(\hat{z}_{ij})}{\Phi(\hat{z}_{ij})}$; $\hat{z}_{ij} = \Phi^{-1}(\hat{p}_{ij})$; and $\hat{\hat{z}}_{ij} = \hat{z}_{ij} + \bar{\bar{\eta}}_{ij}$

All the inferences are based on standard errors that are robust and clustered by host country under the assumption that FDI from OECD countries flowing to a common host country is influenced by the latter's characteristics that apply in common to all source countries, in addition to pair-specific characteristics. If a shock in a host country affects potential investment from all source countries, then FDI inflows are correlated. As Moulton (1990) shows, if errors within groups are correlated, but incorrectly assumed to be independent, standard errors are likely to be substantially biased downward leading to findings of statistical significance that are spurious. In this paper, clustering of standard errors by host country yields the most conservative set of inferences on the significance of coefficients, and is the chosen approach in all the regressions.[28]

2.6 RESULTS

Columns 3 and 4 in Table 2.1 report the main results, obtained from NLS and OLS estimators, respectively. When both the biases introduced by country selection and firm selection are corrected, FDI-specific institutions significantly affect the accumulation of foreign direct investment.

The coefficient of FDI Arbitration – a variable with a close relationship with a judicial regime and enforcement – is significant with the expected negative sign at the 5 percent level, whereas it was not statistically different from zero in the benchmark estimation that does not correct for biases (column 2). An improvement of ten percent in the standardized score for FDI Arbitration (say, from 70 to 77) increases the stock of FDI by at least 4 percent. The coefficient on FDI Procedures is significant in the (biased) OLS estimate of column 2, but its magnitude increases in the bias-corrected estimates of columns 3 and 4. Both FDI Procedures

28 I also cluster standard errors by *source* country (to account for agglomeration tendencies) and by country pairs. Clustering by *source* country makes several coefficients appear much more significant than when clustering is by host country. Note that the magnitudes of coefficients do not change irrespective of how the standard errors are clustered.

and FDI Arbitration coefficients are highly significant after controlling for the general quality of institutions in the country. The coefficient on institutional quality is not positively significant either when it is proxied by the composite WGI indicator or when it is replaced by each of the five separate constituents of WGI in Tables 2.4 through 2.8.

Previous studies (for example, Daude & Stein 2007) found a strong association between good institutions and high FDI inflow. My results suggest that FDI-specific provisions in practice offer direct incentives for FDI in a manner over and above what is offered by good institutions in general. FDI is responsive to specific instruments such as an effective arbitration regime and less onerous business start-up procedures. In the presence of sound FDI-specific provisions, the generally high quality of institutions and governance appears to add no additional attraction to FDI. From a policy maker's perspective, this is not bad news. A minister keen on attracting FDI into her country need not be despondent that it would take decades to overhaul the rule of law or reduce high levels of corruption; she can start with piecemeal reforms in regulation and enforcement that are of direct concern to investors.

The coefficient of FDI Openness, however, is not significant in any of the regressions. This implies that openness to FDI "on paper" is not meaningful. While FDI Procedures and FDI Arbitration indices mainly consist of de facto indicators that assess the implementation of laws and not just the written text, the FDI Openness index comprises solely of de jure indicators. High FDI-receiving countries like Brazil, Russia, India, and China (BRIC), for example, have lower openness scores than countries like Afghanistan and Haiti which receive insignificant amounts of FDI. Obviously BRIC offers conspicuous advantages like market size to investors that small, conflict-ridden economies do not. That, on paper, the poorer countries allow 100 percent ownership of equity should foreigners invest does not seem to matter when most other determinants of FDI are accounted for. This is illustrated in Figure 2.7 with outward *sectoral* FDI data from the United States to 87 IAB coun-

Table 2.1: Determinants of FDI (Main Regressions, 2007-2008)

	(1)	(2)	(3)	(4)	(5)	(6)
	Probit	Benchmark	Heterogeneity		Bias I	Bias II
			NLS	OLS		
FDI Procedures	-.060	.458**	.514**	.501**	.515**	.457**
	(.095)	(.197)	(.200)	(.202)	(.199)	(.203)
FDI Arbitration	-.159**	.260	.411**	.409**	.362*	.300
	(.064)	(.206)	(.200)	(.197)	(.195)	(.206)
FDI Openness	-.113	.054	.141	.127	.119	.061
	(.107)	(.128)	(.126)	(.130)	(.124)	(.126)
Quality of Institutions	.390**	-.111	-.316	-.330	-.337	-.132
	(.153)	(.203)	(.207)	(.208)	(.212)	(.207)
GDP	.624***	.857***	.468***	.496***	.492***	.842***
	(.067)	(.083)	(.124)	(.134)	(.124)	(.092)
GDP Per Capita	-.189*	.036	.150	.141	.143	.008
	(.109)	(.184)	(.190)	(.185)	(.187)	(.180)
Weighted Tariff	-.255*	-.390**	-.026	-.221	-.232	-.387*
	(.137)	(.196)	(.020)	(.206)	(.203)	(.196)
School (Mean Years)	.575***	.295	-.146	-.083	-.081	.323
	(.175)	(.305)	(.328)	(.331)	(.324)	(.302)
Remoteness	2.814***	2.822***	1.251*	1.466*	1.417*	2.787***
	(.459)	(.669)	(.682)	(.798)	(.718)	(.692)
Distance	-1.578***	-1.382***	-.466*	-.550**	-.534**	-1.364***
	(.168)	(.147)	(.236)	(.264)	(.225)	(.155)
Contiguity	.347	1.083**	1.030**	1.066**	1.053**	1.080**
	(.615)	(.454)	(.437)	(.427)	(.430)	(.448)
Colony	.632*	.938***	.544*	.605*	.578*	.937***
	(.363)	(.311)	(.291)	(.310)	(.296)	(.306)
Investment Treaty	.392***	.267				
	(.140)	(.179)				
δ from $\left(\hat{\bar{\omega}}^*_{ij}\right)$			.682***			
			(.201)			
Inverse Mills Ratio $\left(\hat{\bar{\eta}}^*_{ij}\right)$			.177	.003		-.179
			(.358)	(.600)		(.378)
Z1 $\left(\hat{\bar{z}}^*_{ij}\right)$				1.175***		
				(.405)		
H1 $\left(\Phi^{-1}(\hat{pr})\right)$					.663***	
					(.148)	
No.	1578	912	912	912	912	912
Adj. R-sq.		.66	.68	.67	.67	.66

Note 1: robust standard errors (clustered by host country) reported in parenthesis

Note 2: statistical significance indicated as * for p<0.1, ** for p<0.05, and *** for p<0.01

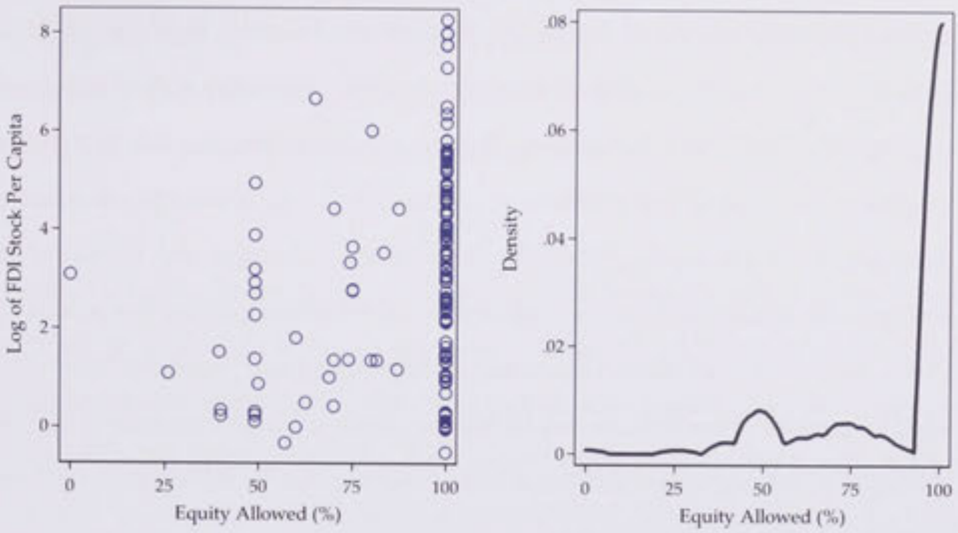
Table 2.2: Determinants of FDI (OECD Source Countries Excluded)

	(1) Probit	(2) Benchmark	(3) Heterogeneity	(4) Bias I	(5) Bias II
FDI Procedures	-.049	.326**	.312*	.334**	.300*
	(.096)	(.156)	(.158)	(.158)	(.156)
FDI Arbitration	-.150**	.246	.379**	.327*	.286
	(.065)	(.196)	(.190)	(.184)	(.192)
FDI Openness	-.092	.072	.117	.106	.082
	(.116)	(.125)	(.132)	(.126)	(.126)
Quality of Institutions	.274	-.130	-.233	-.238	-.078
	(.171)	(.243)	(.257)	(.256)	(.238)
GDP	.668***	.939***	.669***	.659***	.974***
	(.067)	(.082)	(.162)	(.149)	(.088)
GDP Per Capita	-.207*	.140	.210	.210	.105
	(.117)	(.186)	(.192)	(.195)	(.182)
Distance	-1.832***	-1.945***	-1.283**	-1.222***	-2.026***
	(.203)	(.190)	(.503)	(.424)	(.190)
Remoteness	3.823***	4.657***	3.309**	3.153***	4.702***
	(.565)	(.723)	(1.302)	(1.177)	(.756)
Weighted Tariff	-.296**	-.489**	-.363	-.368	-.489**
	(.150)	(.229)	(.225)	(.225)	(.224)
School (Mean Years)	.598***	.108	-.164	-.141	.170
	(.187)	(.327)	(.394)	(.390)	(.332)
Contiguity	.217	2.297***	2.122**	2.143***	2.323***
	(.609)	(.775)	(.819)	(.789)	(.787)
Colony	.494	1.246***	1.029***	1.018***	1.258***
	(.386)	(.289)	(.339)	(.332)	(.301)
Language	.468**	.445	.228	.227	.415
	(.234)	(.279)	(.324)	(.313)	(.283)
Bilateral Investment Treaty	.489***	.296			
	(.151)	(.219)			
Inverse Mills Ratio $\left(\hat{\bar{\eta}}^*_{ij}\right)$			.306		.160
			(.693)		(.430)
Z1 $\left(\hat{\bar{z}}^*_{ij}\right)$			1.204**		
			(.511)		
Z1*Z1			-.116		
			(.094)		
H1 $(\Phi^{-1}(\hat{pr}))$				.448*	
				(.238)	
No.	1220	622	622	622	622
Adj. R-sq.		.62	.63	.63	.62

Note 1: robust standard errors, clustered by host country, reported in parenthesis

Note 2: statistical significance indicated as * for p<0.1, ** for p<0.05, and *** for p<0.01

Figure 2.7: US FDI by Sector and Statutory Openness



Source: IAB and US Bureau of Economic Analysis (www.bea.gov)
Note 1: 87 countries, 5 sectors; 133+ values (out of 435)

tries.[29] There is no systematic relationship between countries' openness score and actual FDI received by sector.

In the bias-corrected models of columns 3 and 4 in Table 2.1, the elasticity of FDI with respect to distance drops dramatically, by two-third, from that in the (biased) benchmark model in column 2. The positive effect of a shared border increases, but the coefficient of common colony falls modestly in the bias-corrected models. Coefficients on remoteness and GDP are also subdued in the bias-corrected models. Coefficients on the average education level of the adult population and the mean level of weighted tariff on manufactured import in host countries are also not statistically different from zero.

A curious result is that the coefficient of GDP per capita is not statistically significant in any of the (bias-corrected) regressions. This raises concern over multicollinearity in the model. As shown in Table 2.17, GDP per capita is highly cor-

29 The five sectors are mining, manufacturing, banking, insurance, and telecommunications. Concordance between the sectors defined by the US Bureau of Economic Analysis and IAB is not exact. FDI stock figures from the US are averaged between 2007 and 2008.

related with the quality of institutions. It is possible that pairwise collinearity in the model exaggerates the variance of some coefficients, either rendering them statistically insignificant or having them carry the "wrong" sign. While there is a debate on whether the quality of institutions makes a country rich or rich countries end up acquiring good institutions, there is no doubt that the two move together in general. To redress the problem of collinearity, I run alternative regressions by dropping GDP per capita. When this is done, the economic and statistical significance of the main coefficients of interest do not change, and the R-squared values of the models do not drop. Ordinarily, a diagnostic exercise of this kind could be used to exclude a variable to reduce the incidence of high collinearity. However, I retain GDP per capita because there is no evidence that its inclusion is contributing to the model's mis-specification.

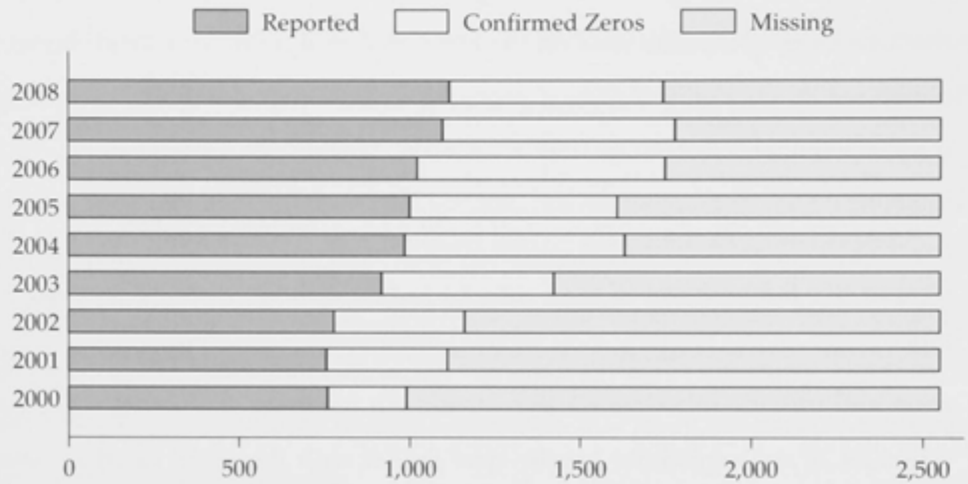
I detail the estimation procedure and additional results in the rest of this section. In Table 2.2, FDI-receiving OECD countries in the sample are dropped so that the FDI relationship is now between the 24 OECD source countries and 65 non-OECD host countries. Coefficients on FDI Arbitration and FDI Procedures are both statistically significant although the magnitudes are lower than in the fuller Regressions on FDI Stock in 2008sample (Table 2.1). The elasticity of distance in the biased regression is much higher than in the main regression, which drops by about one-third when biases are corrected. This indicates that the inclusion of 15 OECD countries in the sample overestimated the effect of FDI-specific provisions and underestimated the hurdle posed by bilateral distance. When the proportion of developing countries in the sample grows, the elasticity of distance increases, indicating that among less developed countries, traditional barriers remain important.

Column 1 of Tables 2.1 and 2.2 show probit estimates of the marginal effects of variables that affect the probability that two countries would have an FDI relationship. OECD countries are more likely to invest in countries whose market size is big, are closer in terms of bilateral distance, and with which they share a colonial and linguistic heritage. They are less likely to go to a country with high trade protection. The propensity to invest in countries with good FDI-specific institutions is low after controlling for the quality of institutions and other country-specific characteristics. The coefficients on the implicit start-up cost for foreign businesses (measured by the number of legal procedures) and openness to FDI are not significant.

Importantly, in the probit model (column 1 in Tables 2.1 and 2.2), the coefficient of BIT is significant at the 1 percent level indicating a strong propensity for OECD countries to invest in host countries that assure protection against expropriation and provide other guarantees for foreign investors. Column 2 reports OLS estimates of an augmented gravity-type model with the same variables used in the probit regression, but without any correction for biases. The coefficient on the BIT variable is not significant, suggesting that it does not affect the volume of FDI after the decision to locate in a country has been made. In other words, it affects the propensity to invest (driven by fixed cost) but not the volume of investment (driven by variable cost). The BIT variable is, therefore, a valid exclusion restriction that is vital for identification in models aimed at correcting truncation biases.

The coefficient of FDI Procedures in the (biased) benchmark regression of column 2 is highly significant. As in the probit estimates, coefficients for GDP, tariff, distance, colonial history, and contiguity are of the same sign and similar magnitude. One major difference between the probit and the biased OLS coefficients is that the coefficient for the quality of institutions is not significant. Remoteness appears to be highly significant and positive, indicating that the relatively distant countries in the sample like the Solomon Islands, Chile, Argentina, Brazil, and Southern African countries are attractive destinations for FDI. This could be because these countries attract resource-based FDI (which is location-specific), or because remote country pairs invest much more in each other than an equi-distant pair elsewhere that is less remote.

Figure 2.8: Outward FDI and Zero Flows from OECD Countries



Source: OECD (2011)
Note 1: 85 IAB host countries, excluding Kosovo and Montenegro

As mentioned earlier, a major problem with log-linearized OLS regression (column 2) is that the sample only includes countries that have an active FDI relationship, and drops all country pairs between which the FDI flow on average between 2007 and 2008 is zero. Over 42 percent of the remaining sample drops out in this manner, which represents not only a mammoth loss of information, as shown in Figure 2.8, but also points to a potential cause of selection bias. After this, the dependent variable is not really bilateral FDI, but bilateral investment contingent on a relationship existing. A crucial variable left out of the model is the probability of being included in the sample, that is, having a non-zero FDI flow. If countries with active FDI relationships are not randomly selected from the population, and the probability of selection is correlated with independent variables like distance, then the gravity coefficients are no longer reliable.

2.6.1 *Country Selection Bias*

Column 5 in Table 2.1 reports results after correcting for selection bias using the standard Heckman procedure. In the first stage, the probit estimates in column 1 give the probability of an FDI relationship existing conditional on the same explanatory variables used to estimate the benchmark equation. An inverse Mills ratio is computed from the conditional probabilities and then included as a regressor in the second stage, which excludes the identifying variable (BIT). The magnitudes of a number of coefficients change modestly between the (biased) benchmark regression and the selection corrected model, but the overall sign and significance are retained. The inverse Mills ratio is also not statistically significant, indicating that the bias arising from country selection is not a serious problem in the case of bilateral FDI. This means that even if countries with zero FDI flows excluded from the country sample in the benchmark regression are now included, the benchmark elasticities of the impact of barriers would not change much.

This result, however, does not undermine the case for the correction of potential selection bias. Indeed, the common practice in the extant gravity literature of making an ad hoc correction to zero flows by recoding zeros as unity, and then including the logged value of unity (zero) in the sample is flawed. This is seen in Table 2.3. The first column reports estimates when the zeros are simply dropped. Columns 2-4 correct for sample selection following three similar approaches: column 2 estimates the full model with maximum likelihood; column 3 reports results from the Heckman two-step model (with probit selection equation estimated with maximum likelihood, and the outcome equation by OLS); column 4 repeats the procedure of column 3 manually. The coefficients are identical, but this approach yields more conservative standard errors.[30] All three approaches confirm that the

30 The two-step approach is more popular and is the one used by Helpman et al. (2008). Verbeek (2004) argues that a full maximum likelihood estimation of the sample selection model is more efficient than the two-step procedure. Further, the OLS regression provides incorrect standard errors because the remaining residual is heteroskedastic and the inverse Mills ratios (lambdas) are not directly observed but estimated from the first stage regression. The two-step method will also not work if the lambdas do not vary much across observations. Verbeek argues that the full maximum likelihood estimation

coefficients of the biased benchmark model do not alter much in the version with correction for sample selection. (The coefficient on the FDI Arbitration variable is, however, significant at the 10 percent level in two of the three models that correct the sample selection bias).

Now, compare the selection corrected estimates of columns 2-4 with those from an ad hoc adjustment in column 5. Coefficients on the FDI-related policy variables, the quality of government and schooling are completely different. Coefficients on the gravity variables, however, are similar in magnitude. Although the R-squared is much higher in the ad hoc regression, the results show that the coefficients vary and inferences would be very different depending on whether the model ignores the zeros (as in column 1), corrects for them (as in columns 2-4), or makes an atheoretical ad hoc adjustment (column 5).

Finally, Santos Silva & Tenreyro (2006) point out that the presence of heteroskedasticity in trade data actually requires the use of *non* log-linearized models. Their method allows the inclusion of zero flows in the sample by estimating the gravity model with original (non-log) FDI as the dependent variable. The results from their Poisson Pseudo Maximum Likelihood (PPML) method in column 6 do not show coefficients on the FDI-related policy variables to be statistically significant, but some variables have surprising coefficients. The elasticity of distance, for example, drops by about two-third as in the main bias-corrected model. An issue with the method proposed by Santos Silva & Tenreyro (2006) in the context of FDI flows is that it does not seek to explain zeros as anything special. In my model, zeros are intimately linked to heterogeneous productivity of firms. A zero bilateral flow indicates that firms are not finding it profitable to invest abroad because, for a given level of foreign demand, either the firm productivity is low, or the fixed and variable costs induced by distance and policy are prohibitive.

(MLE) offers an integrated approach to estimating the parameters. However, MLE requires a stronger assumption that the errors of the selection and outcome equations are jointly normally distributed.

Addressing the zero observation problem (regardless of whether the selection bias is serious or not) still does not give us consistent estimates when firms are heterogeneous. In earlier trade models that follow Krugman (1979), firms are symmetric and all firms export. Only their volume is constrained by trade costs, not the decision of firms of whether to export. When trade barriers are infinite, foreign varieties are still consumed, but zero quantity of each. The effect of trade costs is only on the intensive margin of trade. Helpman et al. (2008) show that the correction of selection bias is inadequate when the assumption of symmetric firms is rejected and firms are not affected by FDI barriers in an *identical* manner.

When firms are heterogeneous, an additional bias needs to be controlled for. As FDI barriers go down, multinational firms face lower variable costs of investing abroad, so they increase their FDI. At the same time, firms that were not productive enough earlier to incur fixed costs are now in a position to do so, and contribute to increased FDI. Both the intensive and extensive margins of adjustment must be acknowledged to obtain an accurate picture of how barriers to FDI affect inflow. Ignoring the extensive margin misattributes the importance of specific barriers in restricting total investment flow because they conflate the impact of FDI barriers on these two separate margins of FDI, and render the coefficients inconsistent (Behar & Nelson 2009). This issue is addressed next, and is illustrated in Figure 2.6.

2.6.2 *Firm Selection Bias*

I follow the two-step methodology proposed by Helpman et al. (2008) to control for unobserved firm heterogeneity in a cross-country data set, as explained in the section on estimation strategy. Column 3 in Table 2.1 reports results from an NLS model that has controls for firm selection $[\ln(e^{\delta \hat{\bar{z}}_{ij}} - 1)]$ and country selection $(\hat{\bar{\eta}}_{ij})$. The coefficient of $\hat{w}_{ij}(\delta)$ is highly significant at the one percent level indicating that there is a severe truncation bias.[31] The coefficient of the inverse Mills ratio, however,

31 In the parametric estimation, I assume delta to be 0.6.

is insignificant. Column 4 in Table 2.1 is exactly the same model as in column 3, except that it is now estimated non-parametrically by OLS after dropping the Pareto assumption and the non-linearity of the unobserved heterogeneity term, which is estimated by a polynomial in $\hat{\bar{z}}_{ij}$ (denoted in the results tables by Z1 and Z2).

In the bias-corrected estimates of columns 3 and 4, the coefficients of FDI Arbitration and FDI Procedures are highly significant even after controlling for the general quality of institutions. Compared to the benchmark regression (column 2), the elasticity of distance drops dramatically from approximately -1.5 to -0.5. The coefficient of FDI Openness is not significant.

In columns 5 and 6, I decompose the country and firm heterogeneity biases to assess which of the two biases is more prominent. Column 5 reports results controlling only for heterogeneity bias and not the selection bias. In column 6, only the sample selection bias is corrected. It is evident that the coefficients in column 5 are close to those in columns 3 and 4, whereas coefficients in column 6 are close to that obtained in the benchmark regression (column 2). This indicates that an overwhelming share of the bias has arisen because of unobserved heterogeneity. While the dominating presence of zero bilateral flows between numerous country pairs potentially posed serious selection bias, I find that in actual estimation, it is the failure to control for unobserved heterogeneity that produces most of the bias in a gravity-like model of FDI.

2.6.3 *Endogeneity Bias*

A pertinent concern in the relationship between FDI regulations and FDI inflow is that regulations could be endogenous to inflow. Improved regulation can be a response by governments to low levels of FDI, or large foreign investors can exercise their influence to lobby governments for regulatory reform *after* choosing to locate. Reverse causation of this nature would imply that errors are not independently and identically distributed leading to inconsistent estimates. Generally, while openness to FDI could be increased by "stroke-of-the-pen" reforms, improvement in institutional practices and provisions are attained only over the long run. In this paper, it is the more institutions-oriented de facto indicators of FDI Procedures and FDI Arbitration that are associated with high levels of FDI, not statutory openness. Further, case studies on FDI policy reforms suggest that major FDI inflows typically follow, not precede, reforms.

I formally test for the exogeneity of FDI regulations with three alternative instrumental variables related to accessing land. The first instrument measures aspects of whether the land registry or cadastre have a publicly accessible inventory of private and public land. The second instrument on the Availability of Land Information scores the richness of 18 pieces of land-related information (for example, plot size, land value, address, previous contracts). And the third instrument captures the time taken (number of days) to lease public or private land in the host country on average (World Bank Group 2010). These instrumental variables are chosen because they are associated with the soundness of domestic institutions; but they are not a determinant of FDI in their own right because a substantial share of aggregate global FDI is in services for which access to industrial land is not as important as for FDI in manufacturing.

The tests follow a three-stage process. First, I conduct the Durbin-Wu-Hausman (DWH) test for the endogeneity of each of the Openness, Arbitration, and Procedures variables. After confirming a high degree of correlation between the potentially endogenous variable and its instrument, Openness is instrumented by the Access to Land Information index, FDI Arbitration is instrumented by the Availability of Land Information index, and FDI Procedures is instrumented by the time it takes to lease private land. I also instrument for all the three variables together. In all the four cases, the p-value of the DWH test is greater than 0.15, which fails to reject the null hypothesis of exogeneity of regressors.

Second, I check for the validity of the instruments in an over-identified model. None of the p-values of the Hansen's *J* chi-squared is less than 0.44; the null hypothesis that the overidentifying restriction is valid is not rejected. Finally, the results reject the null hypothesis of weak instruments for the Openness and Arbitration variables, but not the Procedures variable. However, when the Arbitration and Procedures variables are instrumented together in a just-identified model, the F-statistic exceeds the critical value in the Stock-Yogo test, rejecting the null hypothesis of weak instruments.[32]

2.7 ROBUSTNESS

Three robustness checks are performed on the bias-corrected OLS estimates reported in column 4 of Table 2.1. First, is the high statistical significance of coefficients on FDI Procedures and FDI Arbitration robust to more disaggregated controls for the quality of institutions in lieu of a single composite index? Tables 2.4 through 2.8 replicate the main result by proxying the general quality of institutions by five separate WGI variables. These five indicators are highly correlated with each other (Table 2.18). To avoid multi-collinearity, each is run in a separate regression.

The results for all variables are consistent with the main results. The coefficients for four of the five institutional variables – control of graft, regulatory quality, government effectiveness, and political stability – are not statistically significant after FDI-specific regulations are included in the bias-corrected regressions. The only coefficient attached to an institutional variable that is not statistically insignificant is the rule of law. It is *negatively* significant at the 5 percent level (column 3, Table 2.5). This is perhaps a result of a high degree of correlation between the rule of law and the average income level of the country. When the log of GDP per capita is not included in the regression, the coefficient on the rule of law index is no longer

32 These methods follow Cameron & Trivedi (2009) in checking for regressor endogeneity, overidentifying restrictions, and weak instruments.

significant. In all results, FDI Arbitration and FDI Procedure coefficients retain their high level of significance at either the 5 or 10 percent levels. The elasticity of distance drops as dramatically as in the main result, although coefficients on other gravity variables – colonialism, contiguity and language – are affected only slightly.

In all models, the BIT coefficient is highly significant in the selection equation (column 1) and not in the benchmark outcome equation (columns 2), reaffirming its appropriateness as a candidate for exclusion restriction. It passes the prima facie test of a valid exclusion restriction by being shown to affect the propensity to invest, but not the volume of investment. This point is worth emphasizing because as appealing as the technique for controlling truncation bias is, its efficacy can be stymied by the lack of a convincing exclusion restriction. The main exclusion restriction in Helpman et al. (2008) is religion, which Anderson (2011) does not find convincing. Baranga (2009), too, finds problems with the way Helpman et al. (2008) have used the religion variable. Using an alternative but similar index yields a highly significant coefficient in the benchmark OLS regression, weakening the case for the variable's validity as an exclusion restriction.

Second, how do coefficients change when a dummy for natural resource-rich countries is added to test whether poor countries rich in oil, gas and minerals attract FDI in the extractive industries? To restrict the sample to just developing countries, I drop the FDI-receiving OECD countries. Host countries are assigned a dummy value of one if during 2002 and 2006 their average share of fuel, ores, and metal exports in total exports exceeded 20 percent.[33] In Table 2.9, the coefficient of the resource dummy is not statistically different from zero indicating that resource-rich developing countries are not likely to attract more FDI after controlling for FDI regulations, the quality of institutions, and other host country characteristics. The statistical significance of coefficients of the FDI Procedures and Arbitrations variables is retained.

33 Fuel products belong to SITC Section 3; metals and ores belong to SITC Divisions 27, 28, and 68.

Third, do the main results stand when alternative time periods, namely the individual years of 2006, 2007, and 2008, are considered? I do not consider years prior to 2006 because the explanatory indicators of FDI regulation cover prevailing regimes during or before 2006. Table 2.10 reports results obtained by estimating the model using data for 2006. GDP, GDP per capita, and tariffs averaged over the preceding 5 years, from 2001 to 2005. The basic results not only stand, but the coefficient of FDI Arbitration increases substantially when the dependent variable uses FDI stock for the year 2006. A 10 percent increase in a country's combined score in the Ease of Process and the Judicial Assistance indices increases FDI by over 5.6 percent.

Table 2.11 reports results obtained by estimating the model using data for 2007. Here, both the coefficients of FDI Arbitration and FDI Procedures fall to the extent that the FDI Arbitration coefficient is statistically significant only at the 10.6 percent level.[34] It is conjectured that host country regulations and characteristics matter less when there is a global glut in investment funds. Recall that the year 2007 recorded the highest levels of outward FDI ever in the world. Total FDI stock was valued at nearly US$18 trillion and FDI flows nearly reached the US$2 trillion mark for the first time.

Table 2.12 reports results obtained by estimating the model using data for 2008. The estimates are comparable to the main results, except for the coefficient of the quality of institutions. As in Table 2.5 when it was measured by the rule of law indicator, the coefficient is negative and significant, that is, an improved measure of the rule of law is associated with lower FDI. As stated earlier, this coefficient becomes insignificant when GDP per capita is dropped from the regression.

34 It is significant at the 3 percent level if standard errors are clustered by source country, but I opt for the more conservative estimates.

2.8 CONCLUSION

Gravity models have long been used to explain patterns of trade, investment, and migration flows between countries. They fit the data well, but until recently, they were seen as atheoretical (Anderson & Van Wincoop 2003). This paper uses a new empirical methodology to estimate the impact of FDI-specific regulations on FDI inflow in a theoretically derived gravity-like model.

The traditional estimates obtained from log-linearized models of barriers to FDI are not consistent because they do not account for all the information contained in bilateral data, especially between countries that invest zero amounts in each other (country selection problem). These models also do not acknowledge that firms are heterogeneous and that only a fraction of them are in a position to invest abroad (firm selection problem). The amount of FDI between countries i and j is not just a function of low barriers to FDI, but also of the fraction of firms that invest in country j from country i. Not controlling for the latter assigns exaggerated elasticities to policy costs and gravity variables by conflating the extensive and intensive margins of investment flow.

I find that FDI-specific regulations do matter for attracting FDI. Using a new, painstakingly prepared data set on FDI regulations across 87 countries, I show that de facto implementation of laws related to the arbitration of commercial disputes and the number of procedures required to set up wholly-owned foreign subsidiaries are strongly associated with high levels of FDI stock. These provisions proxy for the quality of FDI-specific institutions in the country, and affect FDI more directly than measures of the *general* quality of institutions.

I also show that it is how the targeted laws and regulation are translated into practice that is important rather than what is written in statutes. This is reflected by the fact that (the coefficient on) openness to FDI, measured by the average percentage of equity permitted to be owned by foreign investors, is not a significant determinant of FDI. Further, the correction of biases dramatically reduces the salience of bilateral distance – a proxy for transaction costs and information asymmetry – as a barrier to inward foreign direct investment from OECD countries.

APPENDIX

2.A DERIVING THE GRAVITY EQUATION FOR FDI WITH HETEROGENEOUS FIRMS

Consumption: A representative consumer prefers variety (ν) and maximizes an iso-elastic utility function $U = [\int x(\nu)^{\rho} d\nu]^{1/\rho}$ subject to aggregate expenditure, $E = \int p(\nu)x(\nu)$. Aggregate expenditures equal aggregate income (Y). The elasticity of substitution across products, $\sigma = 1/1 - \rho$, is the same across countries. When goods 1 to n are continuous, E takes the form $\int_{\Omega} p(\nu)x(\nu)$ where Ω is the "mass" of goods. The consumer optimizes $\Lambda = U^{\rho} - [\int p(\nu)x(\nu)d\nu] - E]$ as follows:

$$\frac{\delta\Lambda}{\delta x(\nu)} = \rho x(\nu)^{\rho-1} - \lambda p(\nu) = 0 \tag{2.A.1}$$

Relative demand for two varieties is:

$$\begin{aligned} \frac{x(\nu_1)}{x(\nu_2)} &= \left[\frac{p(\nu_1)}{p(\nu_2)}\right]^{\frac{1}{\rho-1}} \\ x(\nu_1) &= x(\nu_2)\left[\frac{p(\nu_1)}{p(\nu_2)}\right]^{\frac{1}{\rho-1}} \end{aligned} \tag{2.A.2}$$

Multiplying both sides of (2.A.2) by $p(\nu_1)$ and taking integral with respect to ν_1 : $E = x(\nu_2)p(\nu_2)^{\sigma} \int p(\nu_1)^{1-\sigma} d\nu_1$.

The CES price index (true cost of living index) of all varieties is as follows: $P = [\int_{\Omega} p(\nu)^{1-\sigma} d\nu]^{\frac{1}{1-\sigma}}$.

The Marshallian demand for a variety (v) is:

$$x(\nu) = \frac{Ep(\nu)^{-\sigma}}{P^{1-\sigma}} = \left[\frac{p(\nu)}{P}\right]^{-\sigma} \frac{E}{P} \tag{2.A.3}$$

Production: A country i firm produces one unit of output with a cost-minimizing combination of inputs $(c_i a)$ where a measures the number of bundles of inputs used per unit of output; c_i is the cost of the bundle, which is uniform across country i. A firm's productivity is therefore given by $\frac{1}{a}$. Monopolistic competition with increasing returns implies decreasing average cost as quantity produced increases $[l(x) = f + cx]$. Each firm produces one distinct variety. Each country i has a continuum of firms measured by N_i. Relative size of two countries can therefore be estimated by $\frac{N_i}{N_j}$. There is no strategic interaction among firms, and they only charge a constant mark-up over the marginal cost to maximize profit as follows:

$$\begin{aligned}
\pi_i &= p_i x_i - c_i a x_i - c_i f_i \qquad (2.A.4)\\
\frac{\delta \pi}{\delta p_i} &= x_i + (p_i - c_i a)\frac{\delta x_i}{\delta p_i} = 0\\
p_i &= c_i a - \frac{x_i}{\frac{\delta x_i}{\delta p_i}}
\end{aligned}$$

Substituting $\frac{\delta x_i}{\delta p_i} = -\sigma(p)^{-\sigma-1} E P^{\sigma-1}$ in equation 2.A.4:

$$p_i = c_i a \left[\frac{\sigma}{\sigma-1}\right] = \frac{c_i a}{\rho} \qquad (2.A.5)$$

Investing across borders: Firms serving the foreign market through exports face higher variable costs $(\tau_{ij}^e > \tau_{ij}^f)$ and firms undertaking FDI face higher fixed costs $(f_{ij}^f > f_{ij}^e)$. Production through subsidiary in country j by parent firms in country i reduces transport costs, but there exist non-trivial coordination and transaction costs. For exports, price in country j is $p_i \tau_{ij}^e \equiv \frac{\tau_{ij}^e c_i a}{\rho}$, which differs from price in country i by including bilateral trade costs. For FDI, or more precisely sales by foreign affiliates, the price in country j of products sold by firms headquartered in country i is:

$$p_j = \frac{\tau_{ij}^f c_j a}{\rho} \tag{2.A.6}$$

Note that factor cost is c_i for exporters and c_j for investors. Take $E_j = Y_j$. Substituting equation 2.A.6 in equation 2.A.4, and using equation 2.A.3:

$$\begin{aligned} \pi_{ij} &= p_j x_j - c_j a x_j - c_j f_{ij}^f \\ \pi_{ij} &= (1-\rho)\left[\frac{\tau_{ij}^f c_j a}{\rho P_j}\right]^{1-\sigma} Y_j - c_j f_{ij}^f \end{aligned} \tag{2.A.7}$$

Productivity threshold: Sale by multinational firms from i are profitable in j when $\pi_{ij} \geqslant 0$. This implies that the minimum productivity cut-off a_{ij} required to invest abroad is:

$$a_{ij} = \left[\frac{Y_j(1-\rho)}{c_j f_{ij}^f}\right]^{\frac{1}{\sigma-1}} \frac{\rho P_j}{\tau_{ij}^f c_j} \tag{2.A.8}$$

The cumulative distribution function of the productivity index a is assumed to be a truncated Pareto distribution with support $[a_L, a_H]$. Only firms with productivity $a_L < a < a_{ij}$ invest abroad. This is captured by the fraction of such firms $G(a_{ij}) = \frac{(a_{ij})^k - a_L{}^k}{a_H{}^k - a_L{}^k}$ where k is the shape parameter of the Pareto distribution such that $k > \sigma - 1$. Total sales generated by foreign-owned subsidiaries from i to j are $\int_{a_L}^{a_{ij}} p_j x_j N_i dG(a)$ where $G(a_{ij})$ is multiplied by N_i.

Substituting for p_j and x_j, and characterizing FDI flows, $F_{ij} = \int_{a_L}^{a_{ij}} a^{1-\sigma} dG(a)$ for $a_{ij} > a_L$, the gravity-type equation for FDI is obtained as follows:

$$FDI_{ij} = \left[\frac{\tau^f_{ij} c_j}{\rho P_j}\right]^{1-\sigma} Y_j N_i F_{ij} \qquad (2.A.9)$$

Aggregate FDI sales abroad is the measure of firms N_i multiplied by the average value of FDI of a representative firm. Note that $N_{ij} = N_i G(a_{ij})$. Y_j is the economic size of the host country. F_{ij} can be expressed as $\int_{a_L}^{a_{ij}} a^{1-\sigma} dG(a) = \int_{a_L}^{a_{ij}} \frac{k a^{k-\sigma}}{{a_H}^k - {a_L}^k} da$. Further,

$$\begin{aligned} F_{ij} &= \frac{k}{{a_H}^k - {a_L}^k} * \frac{1}{k-\sigma+1}\left[a_{ij}^{k-\sigma+1} - a_L^{k-\sigma+1}\right] \\ &= \frac{k a_L^{k-\sigma+1}}{(k-\sigma+1)({a_H}^k - {a_L}^k)}\left\{\left[\frac{a_{ij}}{a_L}\right]^{k-\sigma+1} - 1\right\} \end{aligned} \qquad (2.A.10)$$

The first multiplicative term is common across all countries; the second term is specific to i and j, and termed $W_{ij} = \left\{\left[\frac{a_{ij}}{a_L}\right]^{k-\sigma+1} - 1\right\}$. Now, log-linearizing equation 2.A.9, FDI can be estimated in equation 2.A.11. φ_i captures all variables with subscript i as a fixed effect for the FDI source country. φ_j amalgamates country j specific variables: GDP ($\ln Y_j$), factor and policy costs ($\ln c_j$), and inward multi-lateral resistance ($\ln P_j$); w_{ij} captures the ij component of F_{ij}.

$$fdi_{ij} = \alpha_0 + \varphi_i + \varphi_j +_{\iota} d_{ij} + w_{ij} + e_{ij} \qquad (2.A.11)$$

Sample selection: Equation 2.A.11 is observed only for positive values of FDI, that is, $FDI_{ij} = 1$ if $z_{ij} > 0$ where z_{ij} is the latent (unobserved) variable that determines whether country pairs enter into an FDI relationship or not. This latent variable can be estimated by probit conditional on characteristics contained in the outcome equation 2.A.11. Identification requires at least one variable that affects only the propensity of investing but not the actual amount of investment. In other words, this term (ϕ_{ij}) affects fixed cost, but not the variable cost. Equation 2.A.12

specifies the determinants of the latent variable affecting FDI participation. Equation 3.4 calculates the fitted values of the latent variable ($\hat{z}_{ij}$) through predicted probabilities of firms from country i profitably investing in country j, where Φ is the standard normal distribution.

$$
\begin{aligned}
z_{ij} &= \gamma_0 * + \xi_j * + \zeta_i * + \gamma d_{ij} * + \kappa \phi_{ij} * + \eta_{ij} && (2.A.12)\\
Pr(FDI_{ij} = 1 \,|\, z_{ij} > 0) &= \Phi(\gamma_0 * + \xi_j * + \zeta_i * + \gamma d_{ij} * + \kappa \phi_{ij} *) && (2.A.13)
\end{aligned}
$$

Note that the error terms of the selection equation 2.A.12 and the outcome equation 2.A.11 are correlated because the unobserved factors that determine FDI participation also affect the magnitude of FDI. These two error terms are jointly normally distributed. This leads to a sample selection bias because in equation 2.A.11, $E[e_{ij}|FDI_{ij} = 1] \neq 0$. Under the assumptions of the model, there exists a consistent estimator of $E[e_{ij}|FDI_{ij} = 1]$ which is $\frac{\sigma_{e\eta}}{\sigma^2}\bar{\hat{\eta}}_{ij}$, where $\bar{\hat{\eta}}_{ij}$ is the inverse Mills ratio obtained from equation 3.4.

Unobserved heterogeneity bias: The latent variable z_{ij} is related to the productivity of the marginal FDI-undertaking firm. If this firm does not find it profitable to undertake FDI, then no firm from country i will. From equation 2.A.7, the ratio of profits to fixed cost of this firm can be expressed as:

$$
\frac{(1-\rho)\left[\frac{c_j \tau_{ij} a_{ij}}{\rho P_j}\right]^{1-\sigma} Y_j}{c_j f^f_{ij}} \qquad (2.A.14)
$$

Now, define the latent variable $Z_{ij} = \left[\frac{a_{ij}}{a_L}\right]^{\sigma-1}$ where $Z_{ij} = \exp(z_{ij})$.

From equation 2.A.10, $W_{ij} = (Z_{ij})^{\delta} - 1$ where $\delta = \frac{k-\sigma+1}{\sigma-1}$

Z_{ij} is unobserved, but $E[z_{ij}]$ can be estimated by $\hat{z}_{ij}$ from equation 3.4.

Helpman et al. (2008) show that both the sample selection and productivity heterogeneity biases can be redressed in a two-step estimation procedure beginning with the same probit selection equation. However, as explained earlier, to prevent the model from being under-identified, this method requires at least one other variable that enters the probit equation but not the FDI outcome equation to remove the collinearity problem between $\hat{z}_{ij}$ and investment barriers. Without the extra identifying variable, $\hat{z}_{ij}$ is merely a linear combination of the same explanatory variables used in both the selection and outcome equations.

We know that $E[z_{ij}|FDI_{ij} = 1] = E[z_{ij}] + E[\eta_{ij}|FDI_{ij} = 1]$.

Given that the bilateral FDI flow is positive, the expected value of the latent variable can be estimated by $\hat{\hat{z}}_{ij} = \hat{z}_{ij} + \bar{\bar{\eta}}_{ij}$, the sum of the fitted value of the latent variable and the inverse Mills ratio.

In equation 2.A.11, the control for firm selection bias (w_{ij}) is $\ln\{\exp[\delta(\hat{\hat{z}}_{ij})] - 1\}$ and the control for sample selection bias is $\bar{\bar{\eta}}_{ij}$. This is a parametric non-linear regression. When the Pareto assumption is relaxed, Helpman et al. (2008) show that equation 2.A.11 can be estimated non-parametrically in an ordinary least squares (OLS) regression where sample selection is controlled by the inverse Mills ratio $(\bar{\bar{\eta}}_{ij})$ and firm selection is controlled by a polynomial of $\hat{\hat{z}}_{ij}$.

Finally, to sum up the estimation procedure on a practical note, how do I obtain $\hat{\hat{z}}_{ij}$ and $\bar{\bar{\eta}}_{ij}$? A probit model predicts probabilities of positive FDI from a regression that includes the standard gravity variables, host country FDI barriers and dummies for source countries. This includes the identifying variable – BIT – which is excluded in the second stage. From the predicted probabilities, an inverse Mills ratio $(\bar{\bar{\eta}}_{ij})$ is computed. Because the inverse Mills ratio would be undefined for predicted probabilities of 1, all probabilities > 0.9999999 are converted to equal 0.9999999. Next, the fitted values of the latent variable $\hat{z}_{ij} = \Phi^{-1}(\hat{p}_{ij})$ are obtained from the normalized predicted probabilities. This is added to the inverse Mills ratio to obtain $\hat{\hat{z}}_{ij} = \hat{z}_{ij} + \bar{\bar{\eta}}_{ij}$.

2.B FIRM PRODUCTIVITY, EXPORTS, AND HORIZONTAL FDI

The model is from Helpman et al. (2004) and Helpman (2006) where firms vary by productivity which is discovered after entering the industry. Factor cost (c) is country-specific and productivity (inverse of a) is firm-specific. Fixed cost of serving the domestic market is cf_D and the firm charges a marked-up price to maximize profit as follows:

$$\pi_D(\Theta) = \theta(\nu)^{\sigma-1}B - cf_D \text{ where } B = A(1-\rho)(\frac{c}{\rho})^{1-\sigma} \tag{2.B.1}$$

If a firm sells in a foreign country with the same demand elasticity (σ) but different demand function, and faces transport and transaction cost as well as fixed export cost, cf_X, it makes additional profit from exports as follows:

$$\pi_X(\Theta) = \tau^{1-\sigma}\Theta B^j - cf_X \text{ where } \Theta = \theta(\nu)^{\sigma-1} \tag{2.B.2}$$

Firms with productivity $\Theta_D < \Theta < \Theta_X^j$ produce for the domestic market. Those with productivity $\Theta > \Theta_X^j$ export. A firm that undertakes horizontal FDI builds a second plant in country j incurring fixed cost cf_I and variable cost $c_j a$ to reap profit as follows:

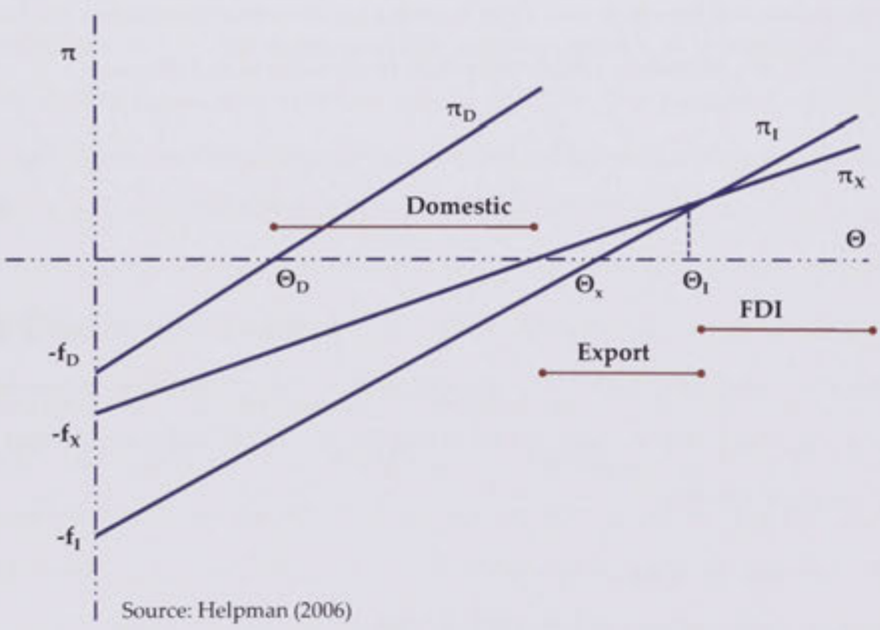
$$\pi_I(\Theta) = \Theta B^j - cf_I \tag{2.B.3}$$

For the case in which demand level is the same in two countries, $B^j = B$, $c_j = c$ and $f_I > \tau^{\sigma-1} f_X > f_D$, the model shows:

$$\Theta_D < \Theta_X^j < \Theta_I^j \tag{2.B.4}$$

This leads to a natural sorting of firms by productivity. If the liberalization of trade or investment reduces marginal costs, not only can firms trade or invest more, but new firms can participate in foreign trade or investment as the productivity cut-off required to do so falls. In Figure 2.9, the profit schedules π_I and π_X swivel backwards. As an example, Baldwin et al. (2003) found that 4.5 percent reduction in Canada-US tariffs increased firms' propensity to export by 63 percent.

Figure 2.9: Sorting of Firms by Productivity



2.C TABLES

Table 2.3: Determinants of FDI (Addressing the Zero Problem)

	(1)	(2)	(3)	(4)	(5)	(6)
	Zero Dropped	MLE	2 Step	2 Step	Ad-hoc	Poisson
			Auto	Manual		
FDI Procedures	.458**	.453***	.457***	.457**	.156	.026
	(.197)	(.125)	(.125)	(.203)	(.103)	(.182)
FDI Arbitration	.260	.305*	.300*	.300	-.187	.226
	(.206)	(.177)	(.177)	(.206)	(.140)	(.594)
FDI Openness	.054	.060	.061	.061	.069	.338
	(.128)	(.110)	(.110)	(.126)	(.092)	(.244)
Quality of Institutions	-.111	-.127	-.132	-.132	.377**	.284
	(.203)	(.153)	(.153)	(.207)	(.144)	(.233)
GDP	.857***	.851***	.842***	.842***	.820***	.738***
	(.083)	(.052)	(.055)	(.092)	(.070)	(.075)
GDP Per Capita	.036	.003	.008	.008	-.096	.027
	(.184)	(.116)	(.117)	(.180)	(.125)	(.214)
Weighted Tariff	-.390**	-.389***	-.387***	-.387*	-.398***	-.191
	(.196)	(.133)	(.133)	(.196)	(.149)	(.286)
School (Mean Years)	.295	.336	.323	.323	.300**	-.112
	(.305)	(.224)	(.225)	(.302)	(.124)	(.499)
Remoteness	2.822***	2.812***	2.787***	2.787***	2.845***	.468
	(.669)	(.395)	(.397)	(.692)	(.444)	(.587)
Distance	-1.382***	-1.380***	-1.364***	-1.364***	-1.395***	-.513***
	(.147)	(.122)	(.126)	(.155)	(.107)	(.083)
Contiguity	1.083**	1.074***	1.080***	1.080**	.937**	-.208
	(.454)	(.347)	(.347)	(.448)	(.449)	(.230)
Colony	.938***	.943***	.937***	.937***	1.070***	.442**
	(.311)	(.290)	(.291)	(.306)	(.316)	(.222)
Language	.889***	.840***	.836***	.836***	.858***	.900***
	(.260)	(.237)	(.237)	(.265)	(.231)	(.226)
Bilateral Investment Treaty	.267				.117	.135
	(.179)				(.124)	(.143)
Inverse Mills Ratio			-.179	-.179		
			(.239)	(.378)		
No.	912	1578	1578	912	1578	1578
Adj. R-sq.	.66			.66	.76	

Note 1: robust standard errors, clustered by host country, reported in parenthesis

Note 2: statistical significance indicated as * for p<0.1, ** for p<0.05, and *** for p<0.01

Table 2.4: Determinants of FDI (Graft)

	(1) Probit	(2) Benchmark	(3) Heterogeneity	(4) Bias I	(5) Bias II
FDI Procedures	-.061	.456**	.494**	.509**	.460**
	(.088)	(.197)	(.201)	(.199)	(.203)
FDI Arbitration	-.126**	.247	.368*	.321	.284
	(.062)	(.205)	(.197)	(.194)	(.205)
FDI Openness	-.112	.058	.126	.120	.065
	(.102)	(.125)	(.127)	(.121)	(.123)
Control of Graft	.292**	-.073	-.209	-.216	-.100
	(.141)	(.187)	(.188)	(.191)	(.188)
GDP	.627***	.857***	.504***	.493***	.839***
	(.068)	(.082)	(.136)	(.124)	(.092)
GDP Per Capita	-.176	.026	.110	.113	.005
	(.120)	(.196)	(.197)	(.199)	(.194)
Weighted Tariff	-.299**	-.378*	-.185	-.192	-.375*
	(.140)	(.191)	(.205)	(.202)	(.192)
School (Mean Years)	.595***	.291	-.079	-.083	.305
	(.188)	(.306)	(.333)	(.327)	(.303)
Remoteness	2.842***	2.823***	1.475*	1.397*	2.786***
	(.464)	(.677)	(.823)	(.735)	(.700)
Distance	-1.572***	-1.381***	-.574**	-.542**	-1.358***
	(.168)	(.147)	(.268)	(.225)	(.156)
Contiguity	.352	1.080**	1.059**	1.040**	1.077**
	(.611)	(.457)	(.427)	(.431)	(.450)
Colony	.652*	.936***	.600*	.563*	.933***
	(.366)	(.311)	(.314)	(.298)	(.306)
Language	.615***	.887***	.509*	.514*	.836***
	(.229)	(.260)	(.279)	(.277)	(.266)
Bilateral Investment Treaty	.413***	.263			
	(.141)	(.180)			
Inverse Mills Ratio $\left(\hat{\eta}^*_{ij}\right)$			.011		-.203
			(.602)		(.381)
Z1 $\left(\hat{z}^*_{ij}\right)$			1.181***		
			(.403)		
Z1*Z1			-.075		
			(.071)		
H1 $\left(\Phi^{-1}(\hat{pr})\right)$				.656***	
				(.149)	
No.	1578	912	912	912	912
Adj. R-sq.		.66	.67	.66	.66

Note 1: robust standard errors, clustered by host country, reported in parenthesis

Note 2: statistical significance indicated as * for p<0.1, ** for p<0.05, and *** for p<0.01

Table 2.5: Determinants of FDI (Rule of Law)

	(1) Probit	(2) Benchmark	(3) Heterogeneity	(4) Bias I	(5) Bias II
FDI Procedures	-.048	.476**	.511**	.526***	.477**
	(.092)	(.190)	(.196)	(.193)	(.196)
FDI Arbitration	-.136**	.278	.409*	.363*	.314
	(.065)	(.213)	(.206)	(.203)	(.213)
FDI Openness	-.097	.046	.109	.100	.051
	(.112)	(.132)	(.134)	(.128)	(.130)
Rule of Law	.277**	-.199	-.348**	-.353**	-.217
	(.122)	(.166)	(.169)	(.171)	(.170)
GDP	.617***	.863***	.511***	.505***	.846***
	(.067)	(.085)	(.133)	(.124)	(.094)
GDP Per Capita	-.139	.080	.155	.156	.052
	(.100)	(.171)	(.170)	(.171)	(.166)
Weighted Tariff	-.293**	-.399**	-.212	-.221	-.395**
	(.132)	(.191)	(.202)	(.199)	(.191)
School (Mean Years)	.541***	.264	-.088	-.087	.287
	(.176)	(.301)	(.325)	(.319)	(.298)
Remoteness	2.886***	2.818***	1.443*	1.384*	2.775***
	(.459)	(.666)	(.803)	(.720)	(.690)
Distance	-1.576***	-1.382***	-.564**	-.543**	-1.360***
	(.168)	(.146)	(.265)	(.225)	(.156)
Contiguity	.342	1.072**	1.056**	1.040**	1.070**
	(.610)	(.457)	(.430)	(.433)	(.450)
Colony	.646*	.951***	.616**	.587**	.947***
	(.365)	(.308)	(.307)	(.293)	(.303)
Language	.606***	.914***	.536*	.548*	.863***
	(.226)	(.263)	(.278)	(.277)	(.269)
Bilateral Investment Treaty	.403***	.257			
	(.141)	(.179)			
Inverse Mills Ratio $\left(\hat{\bar{\eta}}^*_{ij}\right)$			-.013		-.196
			(.608)		(.380)
Z1 $\left(\hat{\bar{z}}^*_{ij}\right)$			1.152***		
			(.411)		
Z1*Z1			-.069		
			(.071)		
H1 $(\Phi^{-1}(\hat{pr}))$				.654***	
				(.147)	
No.	1578	912	912	912	912
Adj. R-sq.		.66	.67	.67	.66

Note 1: robust standard errors, clustered by host country, reported in parenthesis

Note 2: statistical significance indicated as * for p<0.1, ** for p<0.05, and *** for p<0.01

Table 2.6: Determinants of FDI (Regulatory Quality)

	(1) Probit	(2) Benchmark	(3) Heterogeneity	(4) Bias I	(5) Bias II
FDI Procedures	-.033	.437**	.463**	.479**	.435**
	(.092)	(.206)	(.211)	(.208)	(.213)
FDI Arbitration	-.163**	.222	.376*	.328*	.262
	(.073)	(.207)	(.198)	(.196)	(.206)
FDI Openness	-.130	.053	.136	.127	.061
	(.113)	(.125)	(.126)	(.120)	(.123)
Regulatory Quality	.323**	.032	-.150	-.164	.014
	(.154)	(.249)	(.244)	(.250)	(.252)
GDP	.618***	.857***	.505***	.494***	.841***
	(.067)	(.082)	(.139)	(.125)	(.091)
GDP Per Capita	-.136	-.029	.046	.050	-.060
	(.102)	(.192)	(.191)	(.193)	(.189)
Weighted Tariff	-.230	-.355	-.205	-.215	-.353
	(.149)	(.213)	(.225)	(.221)	(.213)
School (Mean Years)	.546***	.334	-.025	-.026	.363
	(.174)	(.311)	(.338)	(.330)	(.308)
Remoteness	2.876***	2.783***	1.418*	1.337*	2.745***
	(.467)	(.678)	(.842)	(.738)	(.701)
Distance	-1.592***	-1.381***	-.553**	-.520**	-1.361***
	(.164)	(.147)	(.278)	(.227)	(.155)
Contiguity	.281	1.085**	1.103**	1.084**	1.083**
	(.610)	(.452)	(.429)	(.433)	(.445)
Colony	.641*	.926***	.596*	.560*	.924***
	(.362)	(.312)	(.314)	(.298)	(.306)
Language	.627***	.867***	.482*	.491*	.814***
	(.226)	(.251)	(.273)	(.269)	(.257)
Bilateral Investment Treaty	.409***	.272			
	(.140)	(.179)			
Inverse Mills Ratio $\left(\hat{\bar{\eta}}^*_{ij}\right)$			.030		-.186
			(.602)		(.377)
Z1 $\left(\hat{\bar{z}}^*_{ij}\right)$			1.209***		
			(.401)		
Z1*Z1			-.078		
			(.071)		
H1 $\left(\Phi^{-1}(\hat{pr})\right)$				.663***	
				(.150)	
No.	1578	912	912	912	912
Adj. R-sq.		.66	.67	.66	.66

Note 1: robust standard errors, clustered by host country, reported in parenthesis

Note 2: statistical significance indicated as * for p<0.1, ** for p<0.05, and *** for p<0.01

Table 2.7: Determinants of FDI (Government Effectiveness)

	(1) Probit	(2) Benchmark	(3) Heterogeneity	(4) Bias I	(5) Bias II
FDI Procedures	-.048	.456**	.492**	.506**	.455**
	(.091)	(.197)	(.202)	(.200)	(.204)
FDI Arbitration	-.150**	.266	.410**	.362*	.306
	(.067)	(.202)	(.192)	(.191)	(.202)
FDI Openness	-.107	.052	.121	.112	.058
	(.108)	(.130)	(.131)	(.125)	(.128)
Govt. Effectiveness	.352**	-.119	-.316	-.322	-.139
	(.153)	(.224)	(.222)	(.227)	(.226)
GDP	.599***	.863***	.518***	.512***	.849***
	(.068)	(.086)	(.137)	(.126)	(.095)
GDP Per Capita	-.153	.037	.120	.122	.008
	(.104)	(.188)	(.187)	(.190)	(.184)
Weighted Tariff	-.252*	-.395**	-.228	-.238	-.392*
	(.147)	(.197)	(.208)	(.205)	(.197)
School (Mean Years)	.552***	.291	-.071	-.071	.318
	(.174)	(.303)	(.329)	(.322)	(.300)
Remoteness	2.859***	2.829***	1.445*	1.392*	2.793***
	(.469)	(.681)	(.829)	(.742)	(.705)
Distance	-1.582***	-1.381***	-.548**	-.529**	-1.362***
	(.167)	(.146)	(.271)	(.229)	(.156)
Contiguity	.317	1.085**	1.079**	1.066**	1.082**
	(.611)	(.453)	(.427)	(.431)	(.447)
Colony	.638*	.941***	.601*	.573*	.940***
	(.367)	(.314)	(.317)	(.300)	(.309)
Language	.602***	.888***	.510*	.522*	.836***
	(.222)	(.258)	(.274)	(.273)	(.264)
Bilateral Investment Treaty	.394***	.265			
	(.139)	(.180)			
Inverse Mills Ratio $\left(\hat{\bar{\eta}}^*_{ij}\right)$			.002		-.180
			(.609)		(.379)
Z1 $\left(\hat{\bar{z}}^*_{ij}\right)$			1.176***		
			(.410)		
Z1*Z1			-.071		
			(.071)		
H1 $(\Phi^{-1}(\hat{pr}))$				.663***	
				(.151)	
No.	1578	912	912	912	912
Adj. R-sq.		.66	.67	.67	.66

Note 1: robust standard errors, clustered by host country, reported in parenthesis

Note 2: statistical significance indicated as * for p<0.1, ** for p<0.05, and *** for p<0.01

Table 2.8: Determinants of FDI (Political Stability)

	(1) Probit	(2) Benchmark	(3) Heterogeneity	(4) Bias I	(5) Bias II
FDI Procedures	-.048	.443**	.482**	.498**	.441**
	(.081)	(.197)	(.203)	(.200)	(.204)
FDI Arbitration	-.132**	.236	.373*	.332	.268
	(.059)	(.208)	(.204)	(.202)	(.209)
FDI Openness	-.119	.054	.136	.126	.061
	(.118)	(.127)	(.129)	(.123)	(.125)
Political Stability	.247**	-.019	-.184	-.193	-.016
	(.109)	(.161)	(.174)	(.167)	(.161)
GDP	.644***	.855***	.462***	.448***	.836***
	(.074)	(.086)	(.146)	(.132)	(.097)
GDP Per Capita	-.146	-.008	.088	.090	-.047
	(.101)	(.172)	(.173)	(.173)	(.162)
Weighted Tariff	-.300**	-.369*	-.173	-.176	-.359*
	(.131)	(.190)	(.200)	(.198)	(.190)
Schooling (Mean Years)	.532***	.327	-.050	-.048	.355
	(.185)	(.309)	(.336)	(.329)	(.306)
Remoteness	2.804***	2.796***	1.385*	1.280*	2.743***
	(.444)	(.648)	(.798)	(.713)	(.677)
Distance	-1.540***	-1.382***	-.528*	-.488**	-1.356***
	(.169)	(.145)	(.269)	(.227)	(.156)
Contiguity	.396	1.086**	1.038**	1.010**	1.086**
	(.630)	(.453)	(.421)	(.430)	(.447)
Colony	.685*	.929***	.559*	.515*	.923***
	(.364)	(.307)	(.305)	(.292)	(.303)
Language	.694***	.872***	.419	.423	.813***
	(.222)	(.257)	(.284)	(.280)	(.263)
Bilateral Investment Treaty	.381***	.273			
	(.140)	(.184)			
Inverse Mills Ratio $\left(\hat{\bar{\eta}}^*_{ij}\right)$			-.060		-.216
			(.614)		(.389)
Z1 $\left(\hat{\bar{z}}^*_{ij}\right)$			1.224***		
			(.413)		
Z1*Z1			-.076		
			(.073)		
H1 $\left(\Phi^{-1}(\hat{pr})\right)$				.706***	
				(.155)	
No.	1578	912	912	912	912
Adj. R-sq.		.66	.67	.67	.66

Note 1: robust standard errors, clustered by host country, reported in parenthesis

Note 2: statistical significance indicated as * for p<0.1, ** for p<0.05, and *** for p<0.01

Table 2.9: Determinants of FDI (Resource-Rich Countries)

	(1) Probit	(2) Benchmark	(3) Heterogeneity	(4) Bias I	(5) Bias II
FDI Procedures	-.032	.356**	.334**	.356**	.329**
	(.092)	(.149)	(.149)	(.152)	(.151)
FDI Arbitration	-.153**	.240	.376**	.321*	.281
	(.065)	(.195)	(.187)	(.183)	(.190)
FDI Openness	-.086	.082	.126	.112	.093
	(.119)	(.130)	(.136)	(.130)	(.131)
Quality of Institutions	.224	-.173	-.255	-.257	-.118
	(.178)	(.211)	(.218)	(.216)	(.202)
GDP	.669***	.941***	.673***	.663***	.978***
	(.068)	(.081)	(.162)	(.149)	(.088)
GDP Per Capita	-.185	.159	.221	.219	.123
	(.121)	(.184)	(.187)	(.190)	(.178)
Distance	-1.835***	-1.937***	-1.282**	-1.222***	-2.024***
	(.203)	(.190)	(.496)	(.418)	(.187)
Remoteness	3.886***	4.692***	3.335**	3.177**	4.745***
	(.602)	(.722)	(1.328)	(1.198)	(.762)
Weighted Tariff (Manu)	-.291*	-.479**	-.355	-.360	-.479**
	(.151)	(.233)	(.228)	(.228)	(.227)
School (Mean Years)	.591***	.106	-.162	-.137	.170
	(.197)	(.331)	(.396)	(.392)	(.335)
Resource Dummy	-.086	-.086	-.053	-.046	-.084
	(.192)	(.226)	(.235)	(.231)	(.223)
Contiguity	.221	2.305***	2.127**	2.149***	2.332***
	(.613)	(.774)	(.818)	(.789)	(.787)
Bilateral Investment Treaty	.491***	.296			
	(.151)	(.219)			
Inverse Mills Ratio $\left(\hat{\bar{\eta}}^*_{ij}\right)$			.335		.177
			(.686)		(.426)
Z1 $\left(\hat{\bar{z}}^*_{ij}\right)$			1.222**		
			(.510)		
Z1*Z1			-.119		
			(.094)		
H1 $(\Phi^{-1}(\hat{pr}))$				.444*	
				(.236)	
No.	1220	622	622	622	622
Adj. R-sq.		.62	.63	.62	.62

Note 1: robust standard errors, clustered by host country, reported in parenthesis

Note 2: statistical significance indicated as * for p<0.1, ** for p<0.05, and *** for p<0.01

Table 2.10: Determinants of FDI (2006 Stock)

	(1) Probit	(2) Benchmark	(3) Heterogeneity	(4) Bias I	(5) Bias II
FDI Procedures	-.130*	.370**	.415***	.437***	.341**
	(.076)	(.155)	(.154)	(.151)	(.157)
FDI Arbitration	-.160*	.491***	.565***	.535***	.513***
	(.096)	(.152)	(.130)	(.139)	(.133)
FDI Openness	-.056	.007	.054	.032	.010
	(.088)	(.112)	(.116)	(.109)	(.115)
Quality of Institutions	.437***	-.080	-.254	-.242	-.049
	(.164)	(.214)	(.204)	(.209)	(.212)
GDP (2001-05)	.756***	.868***	.498***	.575***	.917***
	(.080)	(.080)	(.162)	(.134)	(.086)
GDP Per Capita (2001-05)	-.340***	.062	.228	.203	.020
	(.103)	(.169)	(.174)	(.173)	(.166)
Weighted Tariff (2001-05)	-.286*	-.221	-.073	-.113	-.231
	(.161)	(.198)	(.208)	(.205)	(.201)
School (Mean Years)	.537***	.492*	.191	.235	.578**
	(.206)	(.247)	(.256)	(.255)	(.250)
Remoteness	2.006***	2.621***	1.784**	1.974***	2.708***
	(.465)	(.655)	(.691)	(.639)	(.674)
Distance	-1.289***	-1.272***	-.675***	-.807***	-1.344***
	(.161)	(.136)	(.214)	(.179)	(.146)
Contiguity	.815	1.116**	.918**	.962**	1.127**
	(.570)	(.469)	(.433)	(.434)	(.475)
Colony	.793*	.783**	.408	.488	.825**
	(.432)	(.332)	(.361)	(.339)	(.333)
Language	.782***	.630**	.206	.316	.649**
	(.176)	(.264)	(.285)	(.286)	(.269)
Bilateral Investment Treaty	.273*	.072			
	(.153)	(.183)			
Inverse Mills Ratio $\left(\hat{\hat{\eta}}^*_{ij}\right)$			.560		.495
			(.572)		(.372)
Z1 $\left(\hat{\hat{z}}^*_{ij}\right)$			1.055***		
			(.393)		
Z1*Z1			-.051		
			(.069)		
H1 $(\Phi^{-1}(\hat{pr}))$				.447***	
				(.149)	
No.	1561	881	881	881	881
Adj. R-sq.		.67	.68	.68	.68

Note 1: robust standard errors, clustered by host country, reported in parenthesis

Note 2: statistical significance indicated as * for p<0.1, ** for p<0.05, and *** for p<0.01

Table 2.11: Determinants of FDI (2007 Stock)

	(1) Probit	(2) Benchmark	(3) Heterogeneity	(4) Bias I	(5) Bias II
FDI Procedures	-.110	.333*	.380**	.393**	.333*
	(.106)	(.187)	(.183)	(.182)	(.191)
FDI Arbitration	-.169***	.249	.314	.288	.268
	(.062)	(.206)	(.192)	(.197)	(.201)
FDI Openness	-.080	.054	.098	.084	.055
	(.124)	(.123)	(.126)	(.120)	(.122)
Quality of Institutions	.449***	-.022	-.173	-.179	-.034
	(.158)	(.196)	(.195)	(.199)	(.199)
GDP	.704***	.836***	.563***	.568***	.830***
	(.070)	(.078)	(.144)	(.128)	(.086)
GDP Per Capita	-.306***	.028	.164	.162	.018
	(.107)	(.179)	(.188)	(.187)	(.176)
Weighted Tariff (Manu)	-.353**	-.359**	-.208	-.221	-.357**
	(.146)	(.170)	(.185)	(.176)	(.169)
School (Mean Years)	.477**	.293	.037	.047	.310
	(.198)	(.285)	(.304)	(.295)	(.279)
Remoteness	2.543***	2.635***	1.818**	1.828**	2.628***
	(.475)	(.673)	(.802)	(.730)	(.682)
Distance	-1.530***	-1.367***	-.818***	-.832***	-1.362***
	(.177)	(.142)	(.264)	(.227)	(.151)
Contiguity	.885	1.069**	.953**	.938**	1.058**
	(.614)	(.431)	(.384)	(.394)	(.421)
Colony	.494	.926***	.740**	.732**	.929***
	(.423)	(.321)	(.324)	(.312)	(.318)
Language	.908***	.740***	.379	.409	.717**
	(.232)	(.279)	(.302)	(.301)	(.284)
Bilateral Investment Treaty	.520***	.105			
	(.139)	(.179)			
Inverse Mills Ratio $\left(\hat{\eta}^*_{ij}\right)$			.126		-.064
			(.679)		(.412)
Z1 $\left(\hat{z}^*_{ij}\right)$			.829*		
			(.444)		
Z1*Z1			-.049		
			(.074)		
H1 $\left(\Phi^{-1}(\hat{pr})\right)$				.435***	
				(.146)	
No.	1636	939	939	939	939
Adj. R-sq.		.66	.67	.67	.66

Note 1: robust standard errors, clustered by host country, reported in parenthesis

Note 2: statistical significance indicated as * for p<0.1, ** for p<0.05, and *** for p<0.01

Table 2.12: Determinants of FDI (2008 Stock)

	(1) Probit	(2) Benchmark	(3) Heterogeneity	(4) Bias I	(5) Bias II
FDI Procedures	-.051	.423**	.455**	.477**	.415**
	(.087)	(.188)	(.192)	(.191)	(.192)
FDI Arbitration	-.178***	.260	.435**	.372**	.301
	(.061)	(.194)	(.178)	(.181)	(.187)
FDI Openness	-.114	-.007	.075	.057	-.000
	(.086)	(.109)	(.112)	(.106)	(.108)
Quality of Institutions	.389**	-.155	-.381**	-.387**	-.160
	(.156)	(.187)	(.190)	(.194)	(.188)
GDP	.629***	.847***	.463***	.464***	.856***
	(.065)	(.086)	(.133)	(.123)	(.094)
GDP Per Capita	-.215*	.054	.185	.187	.024
	(.110)	(.180)	(.180)	(.184)	(.175)
Weighted Tariff (Manu)	-.219	-.279	-.115	-.137	-.282
	(.144)	(.189)	(.196)	(.195)	(.189)
School (Mean Years)	.630***	.518*	.100	.089	.567*
	(.185)	(.299)	(.333)	(.318)	(.298)
Remoteness	2.884***	2.736***	1.268*	1.233*	2.769***
	(.442)	(.635)	(.741)	(.648)	(.667)
Distance	-1.569***	-1.340***	-.462*	-.465**	-1.365***
	(.168)	(.147)	(.235)	(.198)	(.155)
Contiguity	.568	1.041**	.874**	.869**	1.031**
	(.619)	(.442)	(.409)	(.416)	(.442)
Colony	.751**	.686**	.284	.252	.695**
	(.377)	(.306)	(.307)	(.297)	(.307)
Language	.626***	.769***	.345	.385	.735***
	(.224)	(.251)	(.271)	(.269)	(.257)
Bilateral Investment Treaty	.312**	.194			
	(.145)	(.177)			
Inverse Mills Ratio $\left(\hat{\bar{\eta}}^*_{ij}\right)$			.271		.062
			(.529)		(.355)
Z1 $\left(\hat{\bar{z}}^*_{ij}\right)$			1.416***		
			(.399)		
Z1*Z1			-.096		
			(.071)		
H1 $(\Phi^{-1}(\hat{pr}))$				.684***	
				(.140)	
No.	1532	853	853	853	853
Adj. R-sq.		.66	.67	.67	.66

Note 1: robust standard errors, clustered by host country, reported in parenthesis

Note 2: statistical significance indicated as * for p<0.1, ** for p<0.05, and *** for p<0.01

Table 2.13: Description and Source of Variables

Variables	Description	Source
Stock of FDI	Log of absolute FDI stock (in US$ million) between two countries. (The main regression results average FDI stock from 2007 to 2008; robustness results use values for individual years 2006, 2007, 2008)	OECD
FDI Arbitration	Log of index (0 to 100) created by averaging two separate IAB indices: i) the Ease of Arbitration Process and ii) the Extent of Judicial Assistance. The former assesses whether there are obstacles that the disputing parties face in seeking a resolution to their dispute; and the latter measures the interaction between domestic courts and arbitral tribunals, including the courts' willingness to assist during the arbitration process and their effectiveness in enforcing arbitration awards.	IAB
FDI Procedures	Log of index (0 to 100) derived by normalizing the number of pre- and post-incorporation procedural steps required to set up a wholly foreign-owned subsidiary.	IAB
FDI Openness	Log of index (0 to 100) of average percentage of foreign equity ownership permitted across 2 primary sectors (mining and oil and gas; agriculture and forestry), 1 light manufacturing sector, and 8 services sectors (from banking and telecommunications to transport and electricity).	IAB
General Quality of Institutions	Weighted sum of five indicators of the Worldwide Governance Indicators (WGI). Weights derived from principle components. (1) Control of Graft measures the extent to which public power is exercised for private gain, as well as capture of the state by elites and private interests. (2) Rule of Law measures the extent to which agents have confidence in and abide by the rules of society, in particular the quality of contract enforcement, the police, and the courts, as well as the likelihood of crime and violence. (3) Government Effectiveness measures the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. (4) Regulatory Quality measures the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. (5) Political Stability captures perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism.	Computed by author from Kaufmann et al. (2010)
GDP	Gross domestic product in current US dollar.	WDI

GDP per capita	Gross domestic product per capita in current US dollar.	WDI
Weighted Tariff	Weighted mean applied tariff is the average of effectively applied rates weighted by the product import shares corresponding to each partner country. When the effectively applied rate is unavailable, the most favored nation rate is used. Manufactured products are commodities classified in SITC revision 3 sections 5-8 excluding division 68.	WDI
Schooling	Log of average number of years of education received by people aged 25 and older in the lifetime based on education attainment levels of the population converted into years of schooling based on theoretical durations of each level of education.	Barro and Lee (2010)
Remoteness	Log of the sum of a country's bilateral distance with all other countries in the world, weighted by the share of the GDP of the partner country in total world GDP.	Computed by author
Distance	Distance in kilometers between two countries using the great circle formula which uses latitudes and longitudes of each country's most populated cities or official capital.	CEPII
Contiguity	1 for pairs of countries that share a border; 0 otherwise	CEPII
Colony	1 for pairs of countries ever in a colonial relationship; 0 otherwise	CEPII
Language (ethnic)	1 if a language is spoken by at least 9 percent of the population in both countries; 0 otherwise.	CEPII
Bilateral Investment Treaty	1 for pairs of countries that have a bilateral investment treaty in force as of 2005; 0 otherwise.	UNCTAD
Access to Land Information index	Log of index (from 0 to 100) that measures aspects of whether the land registry or cadastre have publicly accessible inventory of private and public land; if the inventory is online; if the cadastre shares data about land; and whether there is a publicly accessible land information system or geographic information system.	IAB
Availability of Land Information index	Log of index (0 to 100) which scores countries on 18 pieces of land-related information (for example, plot size, land value, address, previous contracts, existing land claims, tax classification, information on surroundings).	IAB

Table 2.14: Summary Statistics of Variables

	Obs.	Mean	St. Dev.	Minimum	Maximum
FDI Stock (US$ million), 2007-08	1835	3691.18	21210.30	0	437939
Log of FDI Stock, 2007-08	1111	5.39	3.17	-5.99	12.99
FDI Openness (Log)	83	4.27	0.66	0	4.62
FDI Arbitration (Log)	84	4.08	0.68	0	4.53
FDI Procedures (Log)	84	3.95	0.63	0	4.62
Quality of Institutions, averaged 2002-06	84	-0.23	0.82	-1.74	1.76
Bilateral Investment Treaty	1835			0	1
Log of GDP, averaged 2002-06	84	24.42	2.11	19.77	30.11
Log of GDP per capita, averaged 2002-06	84	7.59	1.48	4.99	10.68
School (Log of Mean Years), 2005	84	1.81	0.56	0.10	2.57
Log of Applied Tariff (Weighted Mean, Manufacturing), averaged 2002-06	81	1.88	0.69	0.00	3.10
Log of Remoteness	84	8.95	0.25	8.55	9.42
Log of Distance	1835	8.55	0.90	4.09	9.88
Contiguity	1835			0	1
Colony	1835			0	1
Common Ethnic Language	1835			0	1
Access to Land Information (Log)	83	3.86	0.58	0	4.56
Availability of Land Information (Log)	83	4.13	0.76	0	4.62

Table 2.15: Share of IAB Countries, 2007-2008

	Inward FDI Stock from OECD (US$ billion)	FDI Inflow from OECD (US$ billion)	GDP (US$ billion)	Population (billion)
IAB Countries*	6773.3	810.6	45200	5.77
World	12500	1855.3	58800	6.62
Share	*54.2%*	*43.7%*	*77.9%*	*87.1%*

Source: FDI figures compiled from UNCTAD and OECD sources; GDP and population from WDI

Note 1: *include 84 out of 87 IAB countries (excluding Kosovo, Serbia and Montenegro)

Table 2.16: Lists of Countries

*FDI Source Countries (OECD sample)**

1. Australia 2. Austria** 3. Belgium 4. Canada** 5. Czech Republic** 6. Denmark 7. Finland 8. France** 9. Germany 10. Greece** 11. Hungary 12. Ireland** 13. Iceland 14. Italy 15. Japan** 16. Korea, Rep.** 17. Luxembourg 18. Mexico** 19. The Netherlands 20. Norway 21. New Zealand 22. Poland** 23. Portugal 24. Slovak Republic** 25. Spain** 26. Sweden 27. Switzerland 28. Turkey** 29. United Kingdom** 30. United States**

*Excludes Chile, which became OECD member only in 2010.
**Also in the IAB sample of FDI recipients

FDI Host Countries (IAB sample)

1. Afghanistan 2. Albania 3. Angola 4. Argentina 5. Armenia 6. Austria 7. Azerbaijan 8. Bangladesh 9. Belarus 10. Bolivia 11. Bosnia and Herzegovina 12. Brazil 13. Bulgaria 14. Burkina Faso 15. Cambodia 16. Cameroon 17. Canada 18. Chile 19. China 20. Colombia 21. Costa Rica 22. Côte d'Ivoire 23. Croatia 24. Czech Republic 25. Ecuador 26. Egypt, Arab Rep. 27. Ethiopia 28. France 29. Georgia 30. Ghana 31. Greece 32. Guatemala 33. Haiti 34. Honduras 35. India 36. Indonesia 37. Ireland 38. Japan 39. Kazakhstan 40. Kenya 41. Korea, Rep. 42. Kosovo 43. Kyrgyz Republic 44. Liberia 45. Macedonia, FYR 46. Madagascar 47. Malaysia 48. Mali 49. Mauritius 50. Mexico 51. Moldova 52. Montenegro 53. Morocco 54. Mozambique 55. Nicaragua 56. Nigeria 57. Pakistan 58. Papua New Guinea 59. Peru 60. Philippines 61. Poland 62. Romania 63. Russian Federation 64. Rwanda 65. Saudi Arabia 66. Senegal 67. Serbia 68. Sierra Leone 69. Singapore 70. Slovak Republic 71. Solomon Islands 72. South Africa 73. Spain 74. Sri Lanka 75. Sudan 76. Tanzania 77. Thailand 78. Tunisia 79. Turkey 80. Uganda 81. Ukraine 82. United Kingdom 83. United States 84. Venezuela, R.B. 85. Vietnam 86. Yemen, Rep. 87. Zambia.

Table 2.17: Correlation Among Explanatory Variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) FDI Arbitration	1													
(2) FDI Procedures	-0.002	1												
(3) FDI Openness	-0.020	0.064	1											
(4) Quality of Institutions	0.339	0.182	0.109	1										
(5) GDP	0.351	-0.077	-0.165	0.580	1									
(6) GDP per capita	0.281	0.123	0.103	0.824	0.720	1								
(7) Weighted tariff	-0.196	-0.191	-0.140	-0.658	-0.342	-0.670	1							
(8) Schooling	0.268	0.052	0.192	0.500	0.423	0.677	-0.558	1						
(9) Remoteness	-0.225	-0.276	-0.177	-0.226	-0.120	-0.327	0.342	-0.304	1					
(10) Distance	-0.163	-0.163	-0.082	-0.110	-0.066	-0.156	0.187	-0.156	0.620	1				
(11) Contiguity	0.061	0.060	0.047	0.146	0.093	0.156	-0.143	0.137	-0.203	-0.238	1			
(12) Colony	0.026	0.001	0.038	0.073	0.056	0.060	-0.017	0.018	-0.017	-0.052	0.163	1		
(13) Language	0.076	-0.038	0.044	0.095	0.073	0.038	0.000	0.021	0.071	0.128	0.088	0.360	1	
(14) Bilateral Investment Treaty	0.156	-0.032	-0.038	-0.016	0.109	0.034	-0.009	0.150	-0.092	-0.228	0.046	0.087	-0.071	1

Table 2.18: Correlation Among WGI Variables

	(1)	(2)	(3)	(4)	(5)
(1) Control of Graft	1				
(2) Rule of Law	0.944	1			
(3) Regulatory Quality	0.891	0.908	1		
(4) Government Effectiveness	0.948	0.943	0.948	1	
(5) Political Stability	0.763	0.835	0.720	0.752	1

Table 2.19: Construction of the FDI Openness Variable

Broad industries	Further disaggregation
I. Resource sector	(1) Mining; (2) Oil and gas
II. Primary sector	(3) Agriculture; (4) Forestry
III. Light manufacturing	(5) Light manufacturing; (6) Food products; (7) Pharmaceuticals; (8) Publishing
IV. Telecommunication	(9) Fixed line infrastructure; (10) Fixed line telephony services; (11) Wireless/mobile infrastructure; (12) Wireless/mobile services
V. Electricity	(13) Electric power generation from coal; (14) Electric power generation from solar; (15) Electric power generation from biogas; (16) Electric power generation from hydro; (17) Electric power generation from wind (18) Electric power transmission; (19) Electric power distribution
VI. Banking	(20) Banking
VII. Insurance	(21) Insurance
VIII. Transportation	(22) Railway freight; (23) Domestic air services; (24) International air services; (25) Port operations; (26) Airport operations
IX. Media	(27) Television broadcasting; (28) Newspapers
X. Construction, tourism and retail	(29) Construction; (30) Tourism; (31) Retail distribution services
XI. Health care and waste management	(32) Health care services; (33) Waste management and recycling

Source: World Bank Group (2010)

FDI Openness: This measures the average equity ownership permitted for foreign investors in greenfield investment as well as mergers and acquisitions across 11 sectors, which are themselves averaged equity limits for foreign ownership in 33 sub-sectors listed below. As an example, the Philippines allows 100 percent of foreign ownership in insurance and tourism, but imposes tight restriction in other sectors. In mining, and oil and gas industries maximum foreign equity permitted by the Philippine Constitution is 40 percent unless the investor enters into a 25 year agreement with a minimum investment of $50,000,000. The Constitution also limits foreign capital participation in public utilities (telecommunications and transportation) to a maximum of 40 percent. The media industries (newspaper publishing and television broadcasting) and publishing sector are closed to foreign owners. This gives the Philippines an openness score of 60.06 out of 100. On the other hand, countries that allow 100 percent of foreign equity ownership in all sectors score the maximum of 100. This includes some of the world's least developed countries like Afghanistan, Haiti, Côte d'Ivoire, Rwanda, Senegal and Zambia.

Table 2.20: Construction of the FDI Arbitration Variable

Indices	Issues measured
Ease of Judicial Assistance	(1) Role of the courts in assisting and facilitating arbitration; (2) Role of the courts in confirming, enforcing and setting aside arbitration awards; (3) Time taken to enforce a hypothetical arbitration award.
Ease of Process	(1) Freedom to choose arbitrators' nationality, gender, qualifications, language, seat of arbitration, use of foreign counsel; (2) Tribunal integrity, that is, impartiality and confidentiality; (3) Choice of arbitration methods and institutions; (4) Time taken between filing of request for arbitration to the constitution of a tribunal.

Source: World Bank Group (2010)

FDI Arbitration: This is measured by the average of two indices related to commercial arbitration. The first one is the Ease of Process index, scored from 1 to 100, comparing how easy it is for investors and other parties to design arbitration proceedings in their chosen manner and conduct fair and predictable arbitration. The second is the Ease of Judicial Assistance index, scored from 1 to 100, comparing the extent of judicial assistance to the arbitration proceedings before, during and after the proceedings.

For example, Saudi Arabia has one of the lowest scores (29.5 out of 100) on measures related to arbitration because its laws are not detailed and they impose several restrictions. According to World Bank Group (2010), the arbitrator must be a Saudi national or a Muslim foreigner; in practice, following the Hanbali school of thought arbitrators must be male. The list of arbitrators is determined by the government, hearings must be public, and be conducted in Arabic. Arbitral proceedings must be conducted in accordance with Islamic law and any applicable regulations. There are no legal provisions for court assistance with interim measures and evidence taking during arbitration proceedings. Both domestic and foreign awards are enforced by the Board of Grievances, Commercial Section, which can take up to 56 weeks.

At the other extreme, France is one of the leading forums for international arbitration (scoring 90.3 out of 100). It recognizes international arbitration as involving the interests of international trade. International arbitration does not need to be in writing. French courts strongly support arbitration, upholding an arbitrator's jurisdiction wherever possible. On average, it takes around 5 weeks to enforce an arbitration award rendered in France or in a foreign country, from filing an application to a writ of execution attaching assets (assuming there is no appeal).

Table 2.21: Construction of the FDI Procedures Variable

	Issues
What is counted as a separate procedure	(1) Procedures that must be completed in the same building, but in different offices; (2) If the same office has to be visited several times for different sequential procedures, each is counted separately; (3) Each electronic procedure is counted separately; (4) If two procedures can be completed through the same website but require separate filings, they are counted as two procedures; (5) Procedures required for official correspondence or transactions with public agencies (for example, if a company seal or stamp is required on official documents, such as tax declarations, obtaining the seal or stamp is counted); (6) If a company must open a bank account before registering for sales tax or value added tax, this transaction is counted as a procedure.
What is not counted as a procedure	(1) Procedures that the company undergoes to connect to electricity, water, gas, and waste disposal services; (2) Interactions between company founders or company officers and employees; (3) Industry-specific procedures are excluded (for example, environmental regulations are included only when they apply to all businesses); (4) procedures that are not legal, unavailable to the general public, or not used by the majority of companies.

Source: World Bank Group (2010)

FDI Procedures: This measures the number of pre- and post-incorporation procedural steps formally required to establish a wholly foreign-owned, domestically incorporated company. A procedure is defined as any interaction of the parent company or its legal representatives with external parties (for example, government agencies or notaries). The initial number of procedures that apply to locally-owned SMEs are taken from the Doing Business series of reports (www.doingbusiness.org). Additional procedures required for foreign companies are then added, such as the requirement to submit authenticated legal documentation of the parent company, obtain a trade license, or acquire an investment approval. In countries where there is no difference between the requirements for domestic and foreign companies, the list of procedures is identical to that of Doing Business (World Bank Group 2010).

For example, Canada scores the highest among the 87 countries (100 out of 100) in requiring the least number of legal procedures (two) and time (6 days) for foreign investors to set up a business. According to World Bank Group (2010), foreign companies can file for federal incorporation or provincial registration via Industry Canada's online Electronic Filing Centre. They require no additional procedure other than the post-incorporation notification within 30 days. At the other end, Venezuela scores 10.5 because it requires 19 separate procedures and 169 days, on average, for a foreign business to be set up. The 19 procedures range from authenticating documents at the country of origin to obtaining work permit for foreign workers.

Table 2.22: Composite Country Scores of Selected FDI Regulations

Code	Country	**Investing Across Sectors**	**Arbitrating Commercial Disputes**			**Starting a Foreign Business**
		Average Equity Ownership (1)	*Ease of Process Index* (2)	*Ease of Judicial Assistance Index* (3)	*Average of (2) and (3)*	*(Normalized) Number of Procedures* (4)
AFG	Afghanistan	100.00	0.00	0.00	0.00	89.47
ALB	Albania	95.42	40.70	68.50	54.6	73.68
AGO	Angola	72.20	57.30	59.90	58.6	47.37
ARG	Argentina	91.78	72.20	55.10	63.65	15.79
ARM	Armenia	89.10	82.30	27.30	54.8	68.42
AUT	Austria	93.18	83.70	83.00	83.35	57.89
AZE	Azerbaijan	87.77	53.60	37.00	45.3	73.68
BGD	Bangladesh	100.00	67.50	55.30	61.4	63.16
BLR	Belarus	81.66	79.00	84.90	81.95	78.95
BOL	Bolivia	85.16	65.70	54.20	59.95	15.79
BIH	Bosnia and Herzegovina	92.91	57.10	76.30	66.7	36.84
BRA	Brazil	86.18	45.70	57.20	51.45	21.05
BGR	Bulgaria	98.15	64.70	68.60	66.65	84.21
BFA	Burkina Faso	99.50	67.60	67.90	67.75	84.21
KHM	Cambodia	95.95	48.60	46.00	47.3	57.89
CMR	Cameroon	87.67	79.60	64.60	72.1	36.84
CAN	Canada	81.44	84.70	94.00	89.35	100
CHL	Chile	100.00	62.80	74.80	68.8	52.63

CHN	China	64.93	76.10	60.20	68.15	15.79
COL	Colombia	97.27	52.30	18.20	35.25	42.11
CRI	Costa Rica	94.09	59.00	50.90	54.95	36.84
HRV	Croatia	97.22	71.40	52.70	62.05	63.16
CZE	Czech Republic	98.15	88.50	65.80	77.15	52.63
CIV	Côte d'Ivoire	100.00	82.90	55.80	69.35	47.37
ECU	Ecuador	93.61	58.30	59.80	59.05	26.32
EGY	Egypt, Arab Rep.	87.18	74.90	54.20	64.55	73.68
ETH	Ethiopia	50.00	74.00	34.80	54.4	57.89
FRA	France	87.24	86.60	94.00	90.3	73.68
GEO	Georgia	100.00	75.20	53.60	64.4	89.47
GHA	Ghana	99.09	88.50	40.90	64.7	57.89
GRC	Greece	86.31	86.10	48.60	67.35	15.79
GTM	Guatemala	100.00	72.30	58.40	65.35	47.37
HTI	Haiti	93.55	74.90	28.50	51.7	42.11
HND	Honduras	99.07	73.30	59.50	66.4	31.58
IND	India	74.98	67.60	53.40	60.5	26.32
IDN	Indonesia	71.89	81.80	41.30	61.55	47.37
IRL	Ireland	98.15	79.60	75.80	77.7	84.21
JPN	Japan	84.83	77.70	65.90	71.8	57.89
KAZ	Kazakhstan	88.09	70.40	78.20	74.3	63.16
KEN	Kenya	89.96	77.10	56.30	66.7	47.37
KOR	Korea, Rep.	86.68	81.90	70.20	76.05	52.63
KOS	Kosovo	99.09	63.90	27.50	45.7	52.63
KGZ	Kyrgyz Republic	98.15	72.30	61.70	67	89.47
LBR	Liberia	97.14	56.40	42.00	49.2	68.42

MKD	Macedonia, FYR	98.15	74.90	69.70	72.3	78.95
MDG	Madagascar	97.17	74.20	83.30	78.75	94.74
MYS	Malaysia	67.50	81.80	66.70	74.25	52.63
MLI	Mali	94.91	67.50	8.30	37.9	68.42
MUS	Mauritius	96.36	71.20	77.10	74.15	63.16
MEX	Mexico	63.76	84.70	52.70	68.7	52.63
MDA	Moldova	97.68	81.80	60.90	71.35	63.16
MNE	Montenegro	100.00	60.00	46.50	53.25	36.84
MAR	Morocco	84.87	69.50	64.70	67.1	68.42
MOZ	Mozambique	90.45	80.90	22.20	51.55	47.37
NIC	Nicaragua	96.75	73.30	40.30	56.8	68.42
NGA	Nigeria	97.27	82.30	71.50	76.9	47.37
PAK	Pakistan	83.33	68.50	35.50	52	52.63
PNG	Papua New Guinea	n/a	55.60	26.20	40.9	57.89
PER	Peru	99.07	83.30	62.60	72.95	52.63
PHL	Philippines	60.06	87.00	33.70	60.35	21.05
POL	Poland	93.97	82.80	77.30	80.05	73.68
ROM	Romania	98.15	75.20	93.20	84.2	73.68
RUS	Russian Federation	91.24	76.10	76.60	76.35	57.89
RWA	Rwanda	100.00	80.10	73.30	76.7	94.74
SAU	Saudi Arabia	58.79	30.40	28.60	29.5	78.95
SEN	Senegal	100.00	85.10	98.80	91.95	84.21
SRB	Serbia	97.68	71.40	90.20	80.8	68.42
SLE	Sierra Leone	100.00	70.50	20.50	45.5	68.42
SGP	Singapore	88.58	81.80	93.50	87.65	89.47
SVK	Slovak Republic	98.15	85.70	88.50	87.1	68.42

SLB	Solomon Islands	100.00	0.00	0.00	0	57.89
ZAF	South Africa	91.27	79.00	94.50	86.75	68.42
ESP	Spain	89.96	76.10	75.30	75.7	42.11
LKA	Sri Lanka	85.14	71.30	38.00	54.65	78.95
SDN	Sudan	67.00	73.30	67.80	70.55	42.11
TZA	Tanzania	86.86	74.70	39.10	56.9	36.84
THA	Thailand	52.07	81.80	40.80	61.3	63.16
TUN	Tunisia	97.40	71.40	52.30	61.85	36.84
TUR	Turkey	91.86	69.50	68.60	69.05	68.42
UGA	Uganda	98.70	62.90	39.30	51.1	0.00
UKR	Ukraine	88.83	78.10	72.60	75.35	52.63
GBR	United Kingdom	94.96	87.50	94.50	91	73.68
USA	United States	95.23	81.80	75.30	78.55	68.42
VEN	Venezuela, R.B.	81.84	57.10	52.20	54.65	10.53
VNM	Vietnam	68.75	61.80	57.20	59.5	47.37
YEM	Yemen, Rep.	89.19	81.40	44.00	62.7	63.16
ZMB	Zambia	100.00	65.70	77.30	71.5	63.16

3

ANALYZING TRADE SURVIVAL: WHY DO SO MANY EXPORTS DIE SO EARLY?

> "Death comes with a crawl, or comes with a pounce,
> And whether he's slow or spry,
> It isn't the fact that you're dead that counts,
> But only how did you die?"
> – Edmund Vance Cooke, *Impertinent Poems*, 1903

3.1 INTRODUCTION

This paper examines the cross-national differences in the survival of exports through the lens of product, industry, and country characteristics. Most trade is based on comparative advantage derived from factor endowments, technological differences, or scale economies. If it is assumed that these attributes change slowly because structural transformations take time, a similar assumption should be made about the pattern of trade flows. Actual survival and pattern of exports, however, appear to be much more volatile than implied by traditional theories. In my preliminary analysis of *manufactured* exports between 1997 and 2008 from over 100 developing countries in the world's two largest destinations – United States and the European Union – the median time of survival is between one and two years. This is consistent with earlier findings by Besedes and Prusa (2006*a* & 2006*b*) and Nitsch (2009) who for different time periods and industry aggregates find the median survival of exports to be in the order of one to four years.

Theories have been proposed to explain who is supposed to trade what with whom, but not as much is known about how long trade relationships ought to last. This makes the nascent literature on trade duration of interest to policy makers in developing countries who want to boost trade-led economic growth for which expanding the extensive and intensive margins of exports is paramount.[1] Indeed, countries that have rapidly diversified exports appear to outperform those that are diversifying slowly not in introducing new exports, but in sustaining exports that have already been introduced (Brenton et al. 2009).

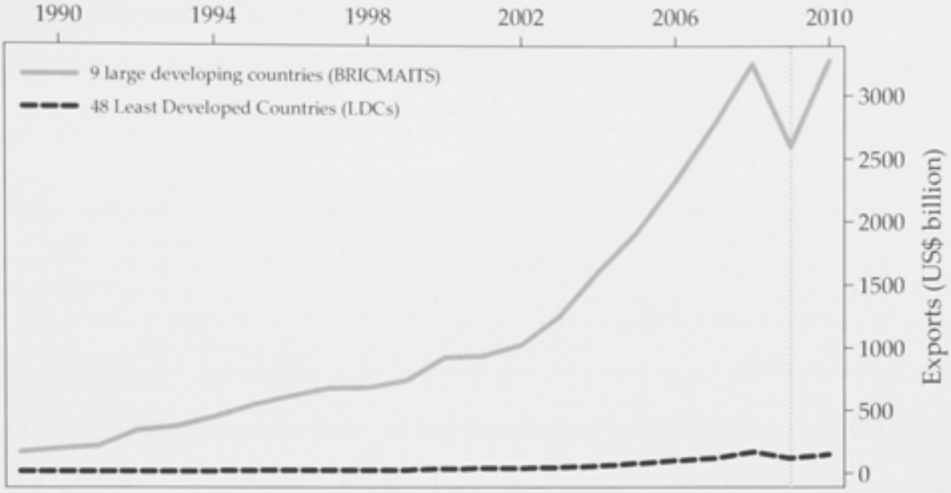
There is great variation in export achievement among developing countries. As shown in Figure 3.1, in just 20 years from 1990 to 2010, total merchandise exports of the nine largest developing countries that are members of the Group of Twenty (G-20) increased by a factor of 17 from US$198 billion to US$3.3 trillion, whereas the poorest 48 LDCs only saw an eight-fold increase from US$19.3 billion to US$150 billion. The larger developing countries are not only experimenting with new products and new markets, but their export of existing products in existing markets is growing faster and lasting longer on average.

To gain insights into the determinants of export survival, I adopt the following approaches in this paper. First, I use a new methodology. Almost all papers that have studied the duration of exports to date use continuous-time models that make the assumption of proportional hazards, and/or do not fully control for unobserved heterogeneity.[2] As demonstrated by Hess & Persson (2011) this is problematic. I use discrete-time regression models that control for unobserved heterogeneity and do not assume proportional hazards. Second, I use novel indices of export diversification and product sophistication to examine the extent to which they are associated with export survival. Third, I analyze survival of exports by

1 At the country-product level, the intensive margin is the export of old products to old markets, and the extensive margin is the export of old products to new markets, new products to old markets and new products to new markets. Narrower definitions at the country level only would not count new products to old markets as a change in the extensive margin.

2 The assumption of proportional hazards is that explanatory variables are independent with respect to time. In other words, the hazard ratio between any two subjects is constant, and a subject's hazard function follows the same pattern throughout the period of study.

Figure 3.1: Merchandise Exports from Developing Countries, 1990-2010



Source: COMTRADE
Note 1: BRICMAITS includes Brazil, Russia, India, China, Mexico, Argentina, Indonesia, Turkey, and South Africa
Note 2: LDCs are officially classified by the United Nations
Note 3: Export values are mirrored, hence inclusive of cost, insurance, and freight

rarely explored product categories (and industries) such as manufactured components[3] and processed foods. Fourth, I discuss the efficacy of tariff preferences and relative real exchange rates in sustaining exports.

I find evidence of information and network externalities from exports that aid survival. Products from countries with concentrated export industries or a narrow range of destination markets exhibit higher rates of death, whereas export concentration *within* some industries is positively associated with survival, suggesting a synergistic network effect. The probability of export death *decreases* with proximity between the capital content of products and national factor endowment, competitive real exchange rate, and bilateral trade preferences. Further, death rates for fast-growing subsets of exports like manufactured components and processed food differ from other manufactured and primary products, respectively, belying the notion that short durations are necessarily a result of poor exporter capabilities.

3 They are interchangeably referred to as parts and components.

I also find that exports that manage to survive the crucial first few years generally end up growing in value: 70 percent of exports that survived at least five years saw their final year's earnings exceed that earned in the initial year; the compound average growth rate was highest for exports lasting eight years, at a remarkable 28 percent per year.

The paper proceeds as follows. Section 3.2 discusses the emerging empirical literature on export survival. Sections 3.3 and 3.4 describe the various theoretical and empirical models that could explain the duration of export flows. Section 3.5 introduces the data and indices. Section 3.6 explains the empirical strategy of obtaining probabilities of export survival in discrete-time models. Sections 3.7 and 3.8 discuss the main results and check for their robustness. The final section concludes.

3.2 RELATED LITERATURE

In traditional theory, trade is caused by productivity differences among countries arising from factor endowments, technology, or economies of scale. Because endowments and technology, as well as the nature of increasing returns that are external or internal to industries evolve slowly, trade theories suggest that patterns of trade ought to be more durable than the recent research on export survival reveals. What explains this apparent incongruency?

Survival analysis is a long established method of inquiry in fields as diverse as political science, industrial engineering, and bio-statistics. In economics, the study of duration data on unemployment goes back to Nickell (1979). The credit for introducing the technique to study durations of trade, however, goes to Besedes and Prusa (2006*a* & 2006*b*). They found that an overwhelming share of imports into the US between 1972 and 2001 failed within the first two years.

Others have since extended the evidence to new countries. Nitsch (2009) shows that German imports have short spells at the 8-digit Combined Nomenclature of

EU trade statistics. Hess & Persson (2010) analyze survival into the European Union (EU) from 1962 to 2006 and find median survival to be only one year. Fugazza & Molina (2009) study bilateral flows among 96 countries and confirm earlier findings on hazard rates differing by income, initial export values, product type, and fixed trade costs. Jaud et al. (2009) find that modern financial systems help export survival by giving firms access to external credit so that they can accommodate shocks and survive longer. Obashi (2010) examines machinery trade within East Asia to find that parts and components are traded through longer-lived and more stable relationships than finished goods.

The papers cited so far use data at the product level. New literature has started to explore export survival by using firm-level data. Volpe & Carballo (2009) study Peruvian firms between 2000 and 2006 to find the median length of an export spell to be just one year. They show evidence in favor of both geographical and product diversification; firms focusing on a larger number of markets manage risk better than those selling a larger number of products.

Cadot, Iacovone, Rauch & Pierola (2011) use firm-level data from four Sub-Saharan African countries to find nation-wide positive spillovers due to the existence of other firms exporting the same product to the same destination. They show that the market and product experience a firm possesses when launching a new product-market combination matters for its survival.[4] An important policy conclusion that Cadot, Iacovone, Rauch & Pierola (2011) reach is that the presence of same-country same-product competitors enables each exporter to amortize market entry costs over a longer run; but because these economies of scale may not be visible enough to induce incumbent exporters to provide assistance to entrants, there arises a market failure which can be corrected with government funds to promote national exports.

4 Market experience of a firm is proxied by the number of products it exports to a particular market. Product experience of the firm is the number of destinations to which it exports that product.

Gorg et al. (2007) use Hungarian firm-level data of over 2000 firms from 1992 to 2003 and find that the more experience a firm has in exporting a product the higher is the chance that the product will survive. Murakozy & Bekes (2009) use the same Hungarian data set to argue that short trade relationships may simply be noise, representing one-off sales of assets and inventories, and that the nature of such temporary trade is different from permanent trade.

Iacovone & Javorcik (2010) use Mexican firm-level data from 1994 to 2003 with sales of over 3000 products to show that many newly introduced exports do not survive for more than one year. They find that i) intense variety churning (turnover) at the firm level is systematically related to exogenous trade reforms and ii) new exporters break into export markets with up to two varieties and a small volume.[5] Iacovone & Javorcik (2010) also show that nearly 80 percent of firms enter new export markets with products that they have recently sold at home. This mitigates risks because if exports fail, unsold goods will still have the domestic market.

The presence of uncertainty causing export volatility is also found in Buono et al. (2008). They investigate the dynamics of export relations using a panel of almost 19,000 French exporters between 1995 and 1999 to find that around 27 percent of all export relations are newly created and 21 percent are destroyed in a typical year.

In terms of methodology, almost all studies (both at the country-product and firm-level) run continuous-time models that make the assumption of proportional hazards. Brenton et al. (2010) were the first to test and reject the assumption of proportional hazards. They use an alternative technique – the Prentice & Gloeckler (1978) estimator[6] – to analyze the duration of export flows from 82 exporters to 53 importers between 1985 and 2005. They find evidence of what they call learning-by-doing: the experience of exporting the same product to other markets or different

5 They find the distribution of export values in the first year, normalized by the total sales of a product by a given firm, to be skewed to the left indicating that most export relationships start small.

6 This is a discrete-time equivalent of the Cox model, that is, a complementary log-log (cloglog) model.

products to the same market enhances the probability of export survival. Brenton et al. (2010) argue that their methodology is superior because they control for unobserved heterogeneity. However, Hess & Persson (2011) point out that while a discrete-time proportional hazards model incorporating random effects does control for unobserved heterogeneity, the model used by Brenton et al. (2010) is still flawed because it does not allow for intrinsic non-proportionality.

This criticism by Hess & Persson (2011) deserves elaboration. There are two reasons why the assumption of proportional hazards fails: i) unaccounted unobserved heterogeneity could force an otherwise proportional effect of a covariate to depend on duration time, or ii) the effect of covariates on hazard could be intrinsically non-proportional. Brenton et al. (2010) argue, rightly, that not accounting for unobserved heterogeneity could cause Cox-based tests to reject the assumption of proportional hazards. They then incorporate random effects to account for unobserved heterogeneity. However, they do not distinguish between intrinsic non-proportionality and non-proportionality caused by heterogeneity. Hess & Persson (2011) conclude that because the assumption of proportional hazards may fail even when controlling for unobserved heterogeneity, discrete-choice models like probit and logit are better in analyzing trade duration.

3.3 THEORETICAL FRAMEWORK

Besedes and Prusa (2006*a* & 2006*b*) relate their findings to the theory of trade and search costs developed by Rauch & Watson (2003). In their model, developed country importers search for developing country exporters. To attenuate uncertainty about suppliers' reliability, importers start with small orders. After investing in training and establishing trust they expand their relationship by placing larger orders, or give up on the relationship altogether and undertake a new search for exporters elsewhere. This reliance on incremental trust-building and reputation is one way to redress the low level of contract enforcement in developing countries.

Segura-Cayuela & Vilarrubia (2008) extend the Melitz model[7] to formally incorporate uncertainty in a model of export flows. Firms seek survival of their exports by lowering uncertainty and informational asymmetry from externalities generated by peer firms who are already exporting to foreign markets. In their framework, it is uncertainty surrounding per-period fixed costs that vary with time that helps explain short trade durations.[8] Firms experiment, face unanticipated hurdles, and quit, releasing information to peers. If the actions of firms that are already exporting reveal enough information, the new exporter does not need to start small.

The basic model is one where firms pay three kinds of costs to enter a foreign market: transport costs (τ_{ij}), sunk costs that are known (c_{ij}) and an unknown fixed cost (f_{ij}) that varies per-period. Sunk costs involve a firm re-orienting its production structure to ready itself for a foreign market; the fixed cost captures the servicing of continued presence after entering (for example, distribution, and adaption to the local market situation). After entering, firms' per-period revenue should meet per-period costs to keep exporting, irrespective of the sunk cost. It is the uncertainty surrounding per-period fixed costs that vary with time that helps explain short trade durations.

In Segura-Cayuela & Vilarrubia (2008), aspiring new exporters observe the actions of previous entrants (from the same industry and country) to derive information on their expected revenue stream.[9] Productivity of firms is assumed to be known, and the more productive firms enter first. A new firm looks to identify the firm with the lowest productivity that ever exported prior to time t. This establishes the upper bound for f_{ij}. A firm with the lowest productivity still ac-

7 In Melitz (2003), only firms whose productivity exceeds an endogenously determined threshold level export. Exporting firms face a higher sunk cost than firms that only serve the domestic market. While Melitz (2003) predicts entry and exit of firms from exporting, such churning is often in response to infrequent trade shocks. In reality, however, firms' profits are subject to uncertainty and likely to vary per period. Because of such variance, there is a constant possibility of old firms exiting and new firms entering at a frequency much higher than that predicted by Melitz.

8 Besedes & Prusa (2010*b*) use this framework as well.

9 The model does not take into account strategic considerations on payoffs, that is, how one's decision to enter might affect other firms' decision to enter by affecting their revenue.

tive at t gives the information that its per-period revenue is at least as high as the per-period fixed cost. Specifically, if the last entrant is not the same as the last remaining active firm, and the latter is more productive than the last entrant, it can be concluded that the last entrant had negative net per-period revenue forcing its exit. Mistakes of prior entrants, therefore, inform a new entrant about the costs of its own entry.

In the model, a firm has to decide whether to enter at time t or wait until $t + 1$ by weighing two different values. If it enters at t, it gets the period's gross revenue minus the sunk cost and the expected fixed cost for a given f_{ij}^{t}. If at $t + 1$, its fixed costs are higher than its per-period revenue, the firm quits the export market; if it is lower, it continues to derive a finite stream of profits. If a firm waits until $t + 1$ to enter, it gets nothing at t, and its payoff is partly conditioned by what information is revealed between t and $t + 1$. With probability p, this waiting firm can become perfectly informed about the true fixed cost by looking at which firm exited and which least-productive firm remains active. It can then enter with certainty that its net per-period revenue will be non-negative at $t + 1$. In this model informational externality is about firm viability captured, for reasons of tractability, by per-period fixed costs. Such informational externalities can take form of tangible facts to intangible tidbits of intelligence.

The corollary of the above framework is that the more diverse the range of firms a country has, or sells to diverse markets, the more information is available to potential new exporters about their viability.[10]

The second strand of theoretical work is on how survival rates vary with product type. Rauch (1996, 1999) discusses the role of trading networks in the

10 Diversification and survival are also discussed in the industrial organization literature, although the determining channel is not informational externality. Bernard & Jensen (2002) find in their study of plant shutdowns in the United States between 1977 and 1997 that the probability of plant death is decreasing in the number of products produced. Single-product plants are much more likely to fail in any five-year period than establishments producing multiple goods. One reason, the authors suggest, why diversification aids survival is related to the finding that the probability of plant death is decreasing in industry sunk costs of entry. To the extent that introducing new products or going into new markets require sunk costs, firms in a position to meet those costs are more productive, and therefore plants that produce multiple products face lower probabilities of shut-down.

presence of uncertainty by dividing goods into "homogeneous," "reference-priced" and "differentiated." The first two groups include commodities that are traded in organized exchanges or whose reference prices can be obtained from trade publications without knowing the name of the manufacturer. The examples of products in this category are agricultural commodities, metals, and chemicals. The price of differentiated goods, on the other hand, varies with the brand of the manufacturer. Because entry of firms that produce differentiated goods reveals more information, duration of trade is expected to be associated with product characteristics. No paper has, however, looked at whether this holds true when products are subject to a detailed classification of sophistication in terms of their factor-content measured by Revealed Factor Intensity (RFI) or income-content measured by PRODY.

From the theoretical discussions so far, two testable characteristics of diversification and sophistication for export survival emerge. The first is whether product and market diversification (at the country level as well as at the industry level) affect survival of exports. The hypothesis is that if a country has i) a large number of export-oriented sectors, or ii) a large number of exports within specific industries, or (iii) a diversified portfolio of export markets, the information externality is likely to be larger and useful in reducing hazard rates.

The second testable characteristic is whether export survival varies with the sophistication of individual products, and not just when they are grouped into broad aggregates as in Rauch (1999). If only a selective subset of firms within developing countries attempts to export "rich-country" products, then the informational externalities they generate may not be enough for aspiring exporters to redress uncertainty. This suggests the higher the sophistication, the higher the mortality of exports. On the other hand, it can be assumed that producers of more sophisticated goods are more productive and better informed about the prospects of their exports in specific markets to reduce their risk of dying. It is also possible that measures of product sophistication are misleading because they generally capture the factor or income content of the final stage of production which may not meaningfully convey the survival chance of products.

3.4 MODEL

Duration data can be in continuous or discrete time. Exports could die on any day of the year, but because cross-country trade data are reported annually, they essentially take the form of discrete *grouped* duration data. However, almost all papers on trade duration have used continuous time models where the dependent variable is the length of an export spell. An export spell is defined as the number of years a product i from Country A is exported continuously (without cessation or death) to Country B. The same product to the same country if revived after a gap of one or more years is treated as another export spell.[11]

In discrete-time models, which I explain later in this section to be my preferred approach, the dependent variable (Y_{it}) is a binary number of either 1 or 0 indicating death or survival of an export i in year t between each country pair. This is used to compute the probability (θ_i) of an export dying conditional on a matrix of explanatory variables $\mathbf{X}$ and their coefficients β as in equation 3.1.

$$\Pr(Y_{it} = 1|\mathbf{X}\beta) = \theta_i \tag{3.1}$$

The first set of explanatory variables comprises measures of export diversification. The diversification indices proxy for informational externality, and ask whether countries with more concentrated export portfolios see less information passed on to fellow exporters about the viability of exports across industries and foreign destinations. All else being equal, survival of exports from countries that

11 This assumption of independence of export spells is defensible because they could represent different firms (later, I control for country-product pairs that have multiple spells, and also treat exports that revive after a gap of only one year as a continuous spell).

rely on a narrow range of export markets or concentrate on few exports could be expected to be lower than from countries with a more diversified export portfolio.

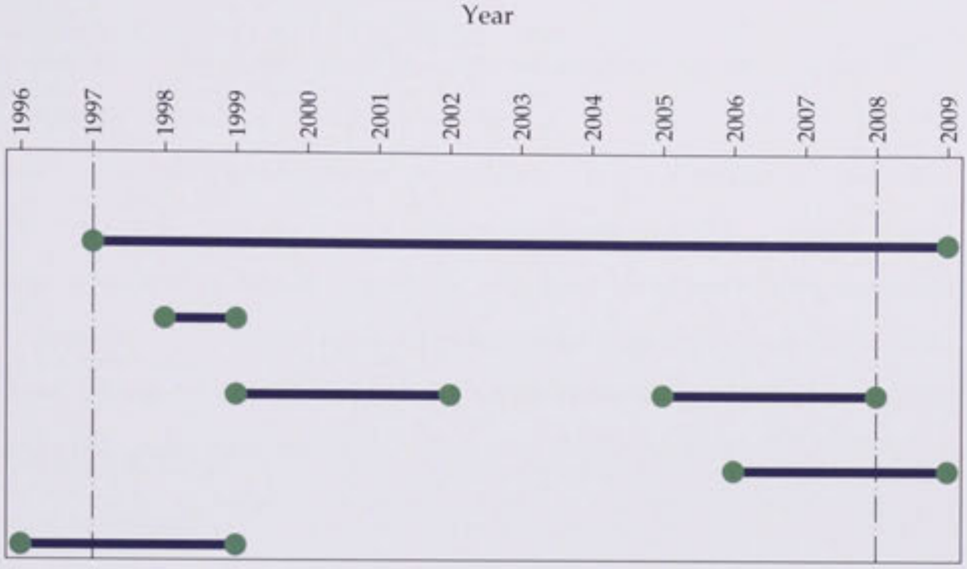
The second set of explanatory variables comprises of measures of sophistication. These measures help answer the question whether exports from developing countries that are more sophisticated than what their existing levels of income and factor endowments suggest die early. If a nation's endowment point is represented by the intersection of the average stock of physical and human capital, the distance between that point and the factor intensities of each export can be calculated. Cadot, Carrère & Strauss-Kahn (2011) and Jaud et al. (2011) hypothesize that, all else being equal, products which defy a country's comparative advantage by embodying human and physical contents that are "far" from the country's point of human and physical capital endowment have a higher rate of failure.[12]

The third set of explanatory variables controls for export experience and competitiveness. In the model of Rauch & Watson (2003), initial value of exports indicates a degree of trust, and an investment already made in the supplier. So relationships that begin with a large order are expected to last longer than those that start small. One explanatory variable is therefore the US dollar value of exports in the year the spell begins. Real GDP and real GDP per capita of exporting countries proxy for the capacity and reliability of exporters. All else being equal, richer countries should expect to have longer spells of export flows. The existence of a Preferential Trade Agreement (PTA) gives a tariff edge to exports from beneficiary countries and attracts foreign investors, increasing the prospect for export longevity.

The fourth set of explanatory variables affects trade and search costs for exporters, best captured by "gravity" variables: all else being equal, export spells between countries that share a language, border, past colonial relationship, and are geographically proximate can be longer. Variable definitions and data sources are elaborated in Table 3.14.

12 I illustrate the concept of factor distance with a country example from Pakistan in Figure 3.5.

Figure 3.2: Duration of Export Flows



Note 1: This is a hypothetical illustration

In addition to the use of a new empirical technique and indices (described later), novel features of this paper include the way export survival is analyzed by industry and two distinct product categories: manufactured components and processed foods. It also assesses whether bilateral trade agreements between the exporting and importing countries, and unilateral trade preferences granted by the importing to the exporting country, are associated with longer survival of exports.

A defining trait of the current era of globalization is that unprecedented technological advances in communications and transportation coupled with liberal trade and investment policies have made possible the splitting of production processes into multiple stages across national borders. This phenomenon is interchangeably known as international product fragmentation, off-shoring, outsourcing, multi-stage production, or vertical specialization. Over the past two decades, the volume of trade in intermediate inputs (parts and components) has risen dramatically, and been likened to the "Third Industrial Revolution" with cheap flow of information and technology augmenting tradability of goods and services in new ways (Blinder 2006).

Trade in parts and components increased from US$1.2 trillion in 1992–93 to US$4.5 trillion (45.5 percent of total exports) in 2006–07, accounting for over a half of the total increment in world manufacturing exports during this period (Athukorala & Menon 2010). This phenomenon has major policy implications.[13] Within networks, production units located in different countries specialize in specific tasks which are not directly substitutable for tasks undertaken elsewhere. They are, therefore, likely to behave differently to finished or final-assembled products. For example, Obashi (2010) finds parts and components to be more robust to long distances or high trading cost, and exchange rate fluctuations.

The other category of distinct products analyzed in this paper is that of agro-based processed foods. It includes fresh fruits and vegetables, poultry, fish and dairy products, which are exported after being subjected to technologically sophisticated processes. As explained by Athukorala & Sen (1998), these exports are typically high value and subject to stringent food safety standards. While they have always been traded, their expansion has been rapid in recent years, and they are distinct from traditional beverages (such as tea and coffee) and cereal grains (such as wheat, maze, rice) which are generally exported in bulk. I hypothesize that the survival rate of processed food exports is different from that of other primary products.

13 First, in the presence of heavy trade in parts and components, relying on final trade data could mislead the direction and magnitude of bilateral trade deficit and surplus. In the famous case of the iPhone, for example, because China assembles and exports the final product, trade data records each iPhone as an export from China to the United States worth US$178.96. However, workers in China's Hon Hai Precision Industry who assemble the iPhone are estimated to contribute only about 3.6 percent (US$6.5) of the wholesale value (Xing & Detert 2010). The rest is accounted for by imported parts and components from several countries. The second implication is for development: product fragmentation makes a finer division of labor possible, and poor countries can leap-frog into producing sophisticated components without waiting to be rich enough to be capable of hosting a fully integrated production chain. Third, parts and components are less sensitive to changes in relative prices, restraining the efficacy of exchange rates in adjusting balance of payments (Athukorala & Menon 2010).

With the data reorganized to indicate the identity of an export spell, its length of survival (in years), and whether the spell is dead or alive at the end of the observation period, two sets of inquiries are conducted in trade duration analysis. The first is the computation of summary statistics on survival rates by region, income groups, and product categories. The second involves regression analysis to test which explanatory variables reduce or increase the risk of export death. Two approaches to regression analysis are described next.

3.4.1 *Continuous-time PH Model*

The probability of export death is formally measured by the hazard rate. It is a function of the baseline hazard h_o at time t, and a set of explanatory variables X. Baseline hazard is the hazard function where all explanatory variables have been set or recentered to zero.

A rising baseline hazard over time implies a *positive* duration dependence, and a falling baseline hazard indicates that the chance of an event occurring decreases over time (*negative* duration dependence). Duration dependence can arise either because there is "true" dependence – it is natural, for example, to expect the risk of fashion-sensitive exports dying to increase with time – or there is unobserved heterogeneity. The existence of unobserved heterogeneity overestimates negative duration dependence and underestimates positive duration dependence. If export categories from different industries have specific unobserved factors that affect their hazard, high-risk exports die sooner leaving low-risk exports to last longer. As time increases, the exit of high-risk exports depletes their population leading to under-estimation of the true population hazard.

The assumption of proportional hazard complicates the use of continuous-time models. The assumption that the effect of a covariate on hazard is constant over time is problematic if we fail to control for unobserved heterogeneity. Even if the model conforms to proportional hazards, the presence of unobserved heterogeneity will cause some covariates to depend on duration time. Before using continuous-time models, the assumption of proportional hazard in the data has to be tested. This step is crucial because research that studies trade duration rarely tests for the proportional hazards assumption before settling on an appropriate model. Indeed, none of the seminal papers that started this body of literature tests for this assumption, with recent exceptions like Brenton et al. (2010) and Hess & Persson (2011).

$$h(t) = \mathrm{Prob}(T = t|T \geqslant t) = f(X\beta) \tag{3.2}$$

When the baseline hazard function is not specified, equation 3.2 is the Cox model of the form $h(t) = h_o\exp(X\beta)$. Cox is semi-parametric and one form of a proportional hazards model. Because the probability distribution of the time-to-event variables need not be known, the Cox model is popular. Yet, the assumption of constant hazard often proves restrictive in application to cover several phenomena of duration. Hazards could decrease or increase, and therefore converge, diverge or even cross the baseline hazard over time. Parametric models such as exponential, Weibull, and Gompertz are appropriate when survival times follow distributions represented by them. For example, constant hazard means the subjects are no more likely to fail at an earlier period than later; in Weibull, failure rates may increase or decrease with time. If proportional hazards models are used to characterize data that have non-proportional hazards, the coefficients are biased and the power of the tests of significance decreases. In such situations, the relative risk of covariates whose hazard ratios are increasing over time is overestimated and the relative risk of covariates with converging hazards underestimated (Box-Steffensmeier & Zorn 2001).

Hess & Persson (2011) articulate a strong case against the use of a Cox proportional hazards model to study the duration of export survival. They offer three reasons, as follows. First, cross-country trade data are available in a comparable format generally in discrete units (of years). Trade data consist of a substantial share of "tied" durations: exports that die in the month of January are recorded to have died the same year as ones that die in December. While there are methods (for example, Breslow and Efron approximations) to deal with tied duration in continuous-time models, biased parameter estimation is inevitable in the presence of heavy ties.[14]

Second, unobserved heterogeneity (also known as frailty) is better dealt with using discrete-time models. Stratified Cox models can address, to some extent, aspects of unobserved heterogeneity by allowing baseline hazards to vary between observations, or by including country dummies. However, in trade data it is likely that heterogeneity is at the level of country *and* industry. This can be addressed more straightforwardly in discrete-time models with random effects.

And third, the Cox model imposes the assumption of proportional hazards, with explanatory variables expected to have a constant effect on the hazard rate. This is untenable, because several variables that affect export survival (for example, initial value of exports, GDP of exporter countries, or trade agreements) are likely to be much more important in the earlier phase of exporting than when exports are sustained for multiple years and hysteresis is observed. In discrete-time models, this assumption can be bypassed.[15]

3.4.2 *Discrete-time Model*

Discrete-time models use an identical likelihood function of binary response, which can be estimated using probit, logit, or complementary log-log (cloglog)

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14 In the data set used in this paper, nearly 50 percent of export spells last only one year (excluding right-censored spells).

15 Hess & Persson (2011) support their methodological recommendation by comparing results from a discrete-time probit model with random effects and the Cox proportional hazards model using the same data set used in Besedes & Prusa (2006*b*). They find significant differences in both the predicted hazard rates and the estimated coefficient of covariates on the hazard.

models.[16] If the probability of an export dying conditional on a set of all covariates is θ_i, then the probability of an export not dying is $1-\theta_i$. In this set-up, the logit, probit and cloglog models are expressed as follows:

$$\textbf{logit}\left[\frac{\theta_i}{1-\theta_i}\right] = \mathbf{X}b = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + ... + b_nX_n \tag{3.3}$$

where $\theta_i = \frac{e^{Xb}}{1-e^{Xb}}$

Similarly for probit,

$$\Phi^{-1}(\theta_i) = Xb \tag{3.4}$$

And cloglog:

$$\log[-\log(1-\theta_i)] = Xb \tag{3.5}$$

where $P(Y_{it} = 1) = \theta_i = 1 - e^{-e^{Xb}}$

Logit and probit may be expected to produce similar results, and cloglog to produce different results because of the asymmetry of its density function. This is, however, not the case. As shown by Sueyoshi (1995), the similarity between probit and logit does not extend to the evaluation of the proportional changes in discrete hazard. Changes in the covariates produce different predictions of proportionate change depending on whether the model is probit, or logit and cloglog. For subjects with high exit probability (as is the case in export data), probit is most sensitive to changes in the explanatory variables.

16 The cloglog model is a discrete-time approximation to the Cox proportional hazards model – the coefficients obtained from cloglog are directly comparable to those obtained from Cox. Indeed, exports die in continuous time, but they are only observed in discrete time intervals. Probit and logit both have symmetrical distribution functions around zero (logit tails are fatter), but cloglog has a skewed distribution.

For a non-parametric baseline I create 11 duration-interval-specific dummy variables for the maximum number of years between 1997 and 2008 (with left-censored data excluded, that is, all exports beginning in 1997 dropped). From the 11 year dummies, I create 4 period dummies corresponding to Year 1, Years 2 and 3, Years 4, 5 and 6, and Years 6 and beyond. The probit model is my first choice. Although computationally time-consuming, I contrast results obtained from the three models with and without frailty (a latent random effect). The random effects model is fit via maximum likelihood in equation 3.6 for $i = 1, ...n$ panels, where $t = 1, ...n; \nu_i$ are identically and independently distributed, and Φ is the standard normal cumulative distributive function.

$$P(y_{it} \neq 0 | \mathbf{x}_{it}) \quad = \quad \Phi(\mathbf{x}_{it}\beta + \nu_i) \tag{3.6}$$

Unobserved heterogeneity is expected to be a major problem in trade data. Even if two export spells P_{ix} and P_{jy} had identical explanatory variables, the product characteristics specific to two different industries (i and j) in two separate countries (X and Y) could result in different hazard rates for export spells. The core set of explanatory variables related to trade and search costs, and informational externalities, are unlikely to account for all the sources of variation in the hazard rate. To address unobserved heterogeneity, I use a model of shared frailty,[17] where export spells belonging to specific industries in each developing country are assumed to share common risks, for example, apparel exports from Kenya face different risks from electrical exports from Kenya. In linear regressions, there are standard techniques to address such heterogeneity, through fixed or random effects. In non-linear models there is no standard methodology (Deb 2001).

Finally, the presence of multiple spells needs to be dealt with. Data on trade duration are replete with exports of identical products from the same country

17 Fixed effects are not generally used in duration models. Instead random effects models are used, which introduce a random parameter into the hazard rate. Export spells share a common intercept. The random frailty terms must be independent of the covariates.

that last one or more consecutive years, stop, and then revive. When data are aggregated by country, it is not known if exports are from the same firm. A priori, it also cannot be known whether export spells that experienced a prior spell are more or less likely to survive on subsequent attempts. The first failure can suggest that the intrinsic hazard rate of a certain product is such that a second failure is more likely. On the other hand, mistakes of the past can be avoided and chances of survival improved the second time. I treat multiple spells as independent, but as in Besedes & Prusa (2006*b*), a dummy controls for any impact of export spells that reappear the second or subsequent time.

It should also be noted that a gap of one year between two export spells could simply be a measurement error. When checking for robustness of results, I treat two export spells separated by a gap of only one year as a single continuous spell to see whether results change when spells are adjusted this way.

3.5 DATA AND VARIABLE CONSTRUCTION

In a data set involving more than 4000 exports from 112 developing countries into the United States over 12 years, there is a maximum possibility of nearly six million units of observations.[18] However, not all countries export all products in all years. I further exclude all exports worth less than US$1000, so in the actual data set, there are 564,956 observations which are converted into 170,088 export spells.

I use mirrored data at the 6-digit level of the Harmonized Commodity Description and Coding System (HS) and concord them with the Standard International Trade Classification (SITC) nomenclature of COMTRADE. Although trade data at the 8-digit, or even 10-digit level, are available from national trade databases of some individual countries, HS 6-digit level is the most disaggregated product classification available in the COMTRADE database for cross-country comparison.

18 Developing countries in this paper are those defined by World Bank (2011*b*) as belonging to either low or middle income categories, with population in 2008 of at least one million. The population cut-off is important to exclude micro-states that do not have the manufacturing base or export structure of larger countries.

There is, of course, an unavoidable risk that disaggregation at the 6-digit level may not adequately capture the uniqueness of some products and hence the survival record is analyzed for highly similar products, not the same product. However, a close inspection of the data suggests that cases of such possible overlap among commodities are few and far between at the 6-digit level compared to the 4-digit level.

SITC is used to group and define commodities into eight manufacturing and four primary industries (Table 3.12). Manufactured goods are those that belong to SITC Sections 5 to 8, net of SITC Division 68. The International Standard Industrial Classification (ISIC) counts processed foods as part of the manufacturing industry. I therefore extract processed food products from the SITC category of food, beverages, tobacco, and live animals (Sections 0, 1, 4 and Division 22, net of Division 43 and Group 121) following the classification of Athukorala & Sen (1998).

I follow the classification of Athukorala (2010) to define 522 products at the HS 6-digit level as parts and components. The share of parts and components is highest, at around 25 percent, among manufactured goods belonging to SITC 7 and 8, and lowest (in fact, almost non-existent) in the chemical industry (SITC 5).

Data for gravity variables that affect trade and search costs are obtained from Centre d'Etudes Prospectives et d'Informations Internationales (CEPII). Real GDP and real GDP per capita are obtained from WDI. Data on US bilateral and unilateral preferential arrangements are obtained from USTR (2011*a*) and USTR (2011*b*), respectively.

An important issue to deal with in survival analysis is the treatment of censored data. They are those without complete information about their duration. Figure 3.2 illustrates hypothetical export spells during the observation period: the bottom two spells are left-and right-censored, respectively, because it is not known when the spell began and when it will end. The longest spell is both left- and right-censored. Only two spells began and ended during the period of observation.

Right-censored data give useful information about the length of time the export flow survived. In other words, an export spell beginning in 2006 and not dead until 2008 is known for certain to have survived for *at least* three years. Left-censored data pose a bigger problem because observations that end in 1997 are given a duration of one year, when in fact they would have lasted for at least one but possibly more years. When spells are recorded as having lasted for fewer number of years than the true length, the hazard rate is underestimated at all durations (Hess & Persson 2011). Next, I describe in detail the construction of indices that are not standard, yet are the main explanatory variables in this paper.

3.5.1 *Measures of Export Sophistication*

The first measure of export sophistication is the "income content" of products (PRODY), calculated by combining the methods of Hausmann et al. (2007) and Lall et al. (2006). The premise is that products largely exported by rich countries are "revealed" as sophisticated. I divide 148 countries into ten income groups, sorted by their level of real GDP per capita in 2007-2008. The income content of each product is the sum of the average GDP per capita income of these ten groups weighted by the ratio of the share of the product in a group's basket to the sum of shares of the product in the overall export basket of all income groups. The weights sum to unity, and are a variant of the Revealed Comparative Advantage (RCA) index. Treating these ten groups as hypothetical countries, I attach the weighted mean per capita income of each group proportionately to the products they export. This assigns implicit productivity numbers to products based on the income character of their exporters.

In equation 3.1, the PRODY of product k is the weighted average of the per capita income (Y_i) of ten income groups producing k with weights calculated as a ratio of the share of k in group i's overall exports to the sum of such shares across all income groups.[19]

$$\text{PRODY}_k = \sum_i \frac{(x_{ik}/X_i)}{\sum_i (x_{ik}/X_i)} * Y_i \tag{3.1}$$

The second measure of sophistication is the Revealed Factory Intensity (RFI) of products. It is computed in a similar manner to PRODY, but has a stronger theoretical linkage to comparative advantage derived from factor endowments. Goods that are predominantly exported by countries rich in human and physical capital are revealed to be intensive in human and physical capital, respectively. The RFI is computed as follows for revealed human capital intensity of products where H_i is the human capital estimated by the average years of schooling. Analogously, the revealed (per capita) physical capital intensity is measured by $\frac{K}{L}$. The physical capital stock (K) is estimated by the perpetual inventory method which reconstructs capital stock estimates from investment flows by recursively adding up current investments to previous period's capital stock with appropriate depreciation.

$$\text{RFI}_k = \sum_i \frac{(x_{ik}/X_i)}{\sum_i (x_{ik}/X_i)} * H_i \tag{3.2}$$

The updated database of factor intensities (human and physical, as well as land and natural resources) of all products at the HS 6-digit level is prepared by Shirotori et al. (2010) and made available by the United Nations Conference on Trade and Development (UNCTAD). I standardize the human and physical capital intensities of each product and calculate the average to capture an overall factor intensity (see Table 3.16 for RFI scores of selected products).

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19 I follow the approach of Lall et al. (2006) to cluster countries into 10 groups sorted by income per capita. Lall et al., however, do not develop an RCA-based weighting system like Hausmann et al. (2007). My approach combines the innovations in the two methodologies.

3.5.2 *Measures of Export Diversification*

I use two measures to compute three different types of export diversification. The first measure of diversification is the Hirschman-Herfindahl (HH) Index. It assesses the overall concentration of exports both at the country level (using aggregated exports at the sectoral level) and within each industry (aggregated exports at the SITC 4-digit level within each of the 12 industries listed in Table 3.12). The HH is also computed for export markets to assess the breadth of foreign destinations for a country's exports. A country with a perfectly diversified export portfolio has an index close to 1, whereas a country which exports only one export has a value of 0 (least diversified). As shown by Jacquemin & Berry (1979), HH cannot be decomposed directly into additive elements which define the contribution of diversification at each level of product aggregation to the total. It also does not capture products with very small trade shares.[20]

Because of these shortcomings, I use Theil's entropy as my second – and preferred – measure of diversification (Theil 1967). Entropy weights the share of each product by the log of the inverse of the share (whereas HH weights the share of each product by itself). High entropy values indicate a diversified export portfolio. If one good is all that a country exports, the entropy is zero. If n goods have an equal share, the maximum value is the log of n. Theil's entropy can be computed for subgroups of exports, and decomposed additively to measure concentration within and among groups of exports. The most concentrated sub-groups have the highest weights. In equations 3.3 and 3.4 S_{ij} is the share of export j in the total exports of country i.

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20 If two products at the SITC-4 digit level have shares of 80 and 20 percent within a SITC-2 category, the entropy is 0.217 and the HH is 0.32 (subtracted from 1 to show that increase in the scores in both measures indicates increased diversification). Now, assume that the 20 percent share of the second product was distributed equally among 10 products, but the first product still dominated with an 80 percent share – the entropy jumps to 0.417 whereas HH only increases to 0.356. The entropy is, therefore, much more responsive to changes in small product shares, whereas HH is more responsive to small differences in large product shares.

$$\text{Entropy} = -\sum_j S_{ij} \ln(S_{ij}) \quad (3.3)$$

$$\text{HH} = 1 - \sum_j (S_{ij})^2 \quad (3.4)$$

3.5.3 *Distance from National Endowment Point*

From the UNCTAD data set on RFI, I compute the distance between the capital content of each product p and the national endowment of each country i as follows. Following Jaud et al. (2011), equation 3.5 is the Euclidean distance computed by first standardizing (to have mean zero and a standard deviation of one) the difference in the logged values of the revealed physical capital (k_{ip}) and human capital (h_{ip}) contents and the national endowment $(k_i \, h_i)$. An alternative measure in equation 3.6 is the *absolute* distance of product p from the point of comparative advantage.

$$\text{Euclidean Distance}_k = \left[\left\{\mathbf{std}(\mathbf{k_i} - \mathbf{k_{ip}})\right\}^2 + \left\{\mathbf{std}(\mathbf{h_i} - \mathbf{h_{ip}})\right\}^2\right]^{1/2} \quad (3.5)$$

$$\text{Absolute Distance}_k = |\mathbf{std}(\mathbf{k_i} - \mathbf{k_{ip}})| + |\mathbf{std}(\mathbf{h_i} - \mathbf{h_{ip}})| \quad (3.6)$$

3.5.4 *Relative Real Exchange Rate*

The real exchange rate is the nominal exchange rate adjusted for price levels in more than one currency. It is often used as an indicator of export competitiveness. I compute *relative* real exchange rate of each country vis-à-vis the US in all years as follows. First, all nominal exchange rates between a country's currency against the US dollar are converted into indices with 2005 as the base year. Second, the nominal exchange rate indices are multiplied by the ratio of the consumer price indices in the importing and exporting countries. Third, the real exchange rate thus obtained is divided by the real exchange rate of all other developing countries exporting to the US, weighted by each country's share of manufactured exports. The movement of real exchange rate reflects the change in a country's international competitiveness: a decrease in the relative real exchange rate index between two years implies that the country's exchange rate has become less competitive relative to that of other countries.[21]

3.6 ESTIMATION METHOD

Taking time-to-event (T) to be a random variable, the two important concepts in duration analysis are the hazard and survival functions. The hazard function is defined in equation 3.1, where $P(.)$ is the probability that an event occurs instantly after t given that no event has occurred until t. For example, if 100 subjects enter period t, and 20 die ("an event occurs") before $t+1$, the hazard, $H(t)$, is 0.2.

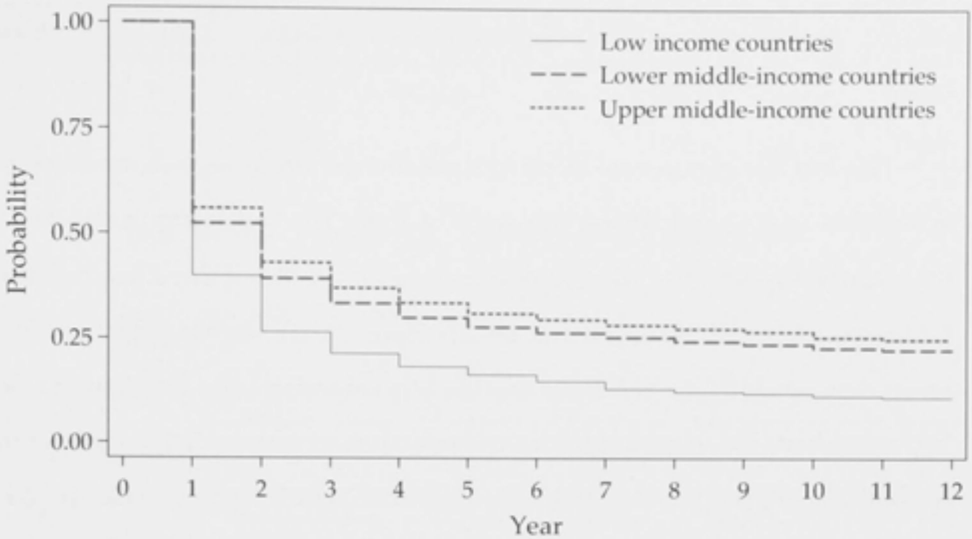
$$H(t) = \lim_{dt \to 0} \frac{P(t \leqslant T < t + dt | T \geqslant t)}{dt} \tag{3.1}$$

$$\hat{S}(t) = \prod_{j | t_j \leqslant t} \left(\frac{n_j - d_j}{n_j} \right) \tag{3.2}$$

The survival function is the conditional probability that an event has not occurred before time t. The Kaplan-Meier (KM) survival rate is a non-parametric estimate of the Survivor function $S(t)$ which is estimated by equation 3.2, where n_j is the number of exports at risk at time, and d_j is the number of failures or deaths at time t_j. The product is over all time periods with failures until t_j. In Ta-

21 Take Nepal as an example. According to World Bank (2010*b*), in 2002, Nepal's nominal exchange rate was Rs. 77.9 per US dollar. Converted into an index with the nominal exchange rate in 2005 (Rs. 71.4 per US dollar) set to 100, the 2002 index is 109.1. This is multiplied by the ratio of US and Nepali consumer price indices in 2002 (92.1/86.1) to obtain a real exchange rate of 116.7. This is then divided by the weighted average of real exchange rates of all countries that export to the US (109.26) to give Nepal its relative real exchange rate in 2002 of 1.068. This increased to 1.075 in 2003, indicating real depreciation of Nepal's exchange rate relative to other countries. This makes Nepali exports more competitive and reduces the share of export deaths to a level lower than would otherwise have been the case.

Figure 3.3: Kaplan-Meier Survival Estimates of Exports to the US



Source: Computed by author from trade data in COMTRADE
Note 1: Years span 1998 to 2008

ble 3.11, the probability that an export from Sub-Saharan Africa to the US survives until the 11th year, $\hat{S}(11)$, is about 11 percent; the probability that an export from East Asia to the US survives until the sixth year, $\hat{S}(6)$, is 40 percent.

Figure 3.3 depicts the Kaplan-Meier (KM) estimates graphically for all export spells to the US. The probability that an export survives beyond the first year is 0.56 for upper-middle-income countries, 0.52 for lower-middle-class countries and 0.4 for low-income countries. The downside of the Kaplan-Meier estimate is that it cannot control for covariates, for which regression results are required, as described next.

It was argued earlier that the use of the Cox proportional hazards model is unsuitable to study the duration of exports. I, therefore, formally check for the assumption of proportional hazards based on a generalization by Grambsch & Therneau (1994). At their core, tests of non-proportionality involve testing whether γ in an augmented version of equation 3.3 is zero where covariates are allowed to vary according to some function $q(.)$ of time.

$$h(t) = h_0 \exp(X\beta + q(t)X\gamma) \tag{3.3}$$

This is a test of non-zero slope in a generalized linear regression of the scaled Schoenfeld (n.d.) residuals on functions of time. The test retrieves the residuals, fits a smooth function of time to residuals and examines if there is a relationship (Cleves et al. 2008). Box-Steffensmeier & Zorn (2001) summarize the technique as one of rescaling the residuals for the kth covariate as in equation 3.4 where V_{kt}^{-1} represents the contribution to the information matrix. If the assumption of constant hazard holds, Schoenfeld residuals should be a random walk over a range of survival times showing no relationship between a spell's residual for a particular covariate and the length of survival.[22]

$$s_{kt}^{*} = \hat{\beta}_k + s_{kt} V_{kt}^{-1} \tag{3.4}$$

As shown in Table 3.13, the assumption of proportional hazards is rejected for *all* variables. There is no justification for using a proportional hazards model because the null hypothesis of a constant effect of all covariates on the hazard rate is rejected at the 1 percent level. This is not surprising because it is plausible to think of several covariates (such as trade preferences, or bilateral distance) that can influence the hazard rate (relative risks) of an export spell from one region (say, apparel exports from Bangladesh) to not be proportional to another export spell from elsewhere (say, semiconductor exports from Costa Rica).

I reorganize the continuous-time data as in Table 3.1 to suit a discrete-time model. As shown in Table 3.2, each export spell is expanded so that for every spell there are as many observations as there are time periods. An export spell that is

22 A smoothed plot of s_{kt}^{*} against survival time gives a direct estimate of γ in equation 3.3. To then test the null hypothesis that the log hazard-ratio function is constant over time, the Stata command <estat phtest> is used which automates the process of regressing Schoenfeld and scaled Schoenfeld residuals on time.

Table 3.1: Data Structure for Continuous-Time Survival Analysis

Spell ID	Spell Length	Censor	1st Year	Last Year	Exporter	HS Code	Product
1	2	1	2007	2008	Brazil	293791	Insulin
28	3	0	1999	2001	China	481620	Paper

Table 3.2: Data Structure for Discrete-Time Survival Analysis

Spell ID	Death	1st Year	Last Year	Exporter	HS Code	Product	Covariates
1	0	2007	2008	Brazil	293791	Insulin	X
1	0	2007	2008	Brazil	293791	Insulin	X
28	0	1999	2001	China	481620	Paper	X
28	0	1999	2001	China	481620	Paper	X
28	1	1999	2001	China	481620	Paper	X

three years long is accorded three rows of data with binary dependent variable equaling zero for all years when the export is active or is censored – and unity for the last year of the spell when the flow ceases. I then create duration-interval specific dummy variables for each year the export is at risk (that is, 12 years during the period 1997 to 2008).

For each unit of more than 420,000 observations, the binary dependent variable on the left hand side is matched on the right hand side by explanatory variables corresponding to either the first year of the export spell or one year prior. The diversification measures and the real exchange rate are lagged one year because they are expected to affect the probability of survival the following year. In other words, entropy measures for 1997 appear as possible determinants of export survival in 1998. The unique sophistication scores of products and gravity variables are assumed to be time-invariant. GDP, GDP per capita and the dummy for BTA vary with time.

Following the convention in the literature, I drop all observations with left-censored spells. This affects 23.3 percent of the spells in the data set.[23] The results are derived from three discrete-time models (probit, logit, and cloglog). They control for unobserved heterogeneity at the country-industry level by fitting a random effects model via maximum likelihood. In a commonly-used statistical software like Stata (version 11.2) this is a highly time-consuming technique because the likelihood function is calculated by adaptive Gauss-Hermite quadrature, and the computation time is proportional to the size of the data set.[24]

3.7 RESULTS

Tables 3.3 and 3.4 show the main results with product sophistication measured by RFI and PRODY, respectively, in models where diversification is measured by both Entropy and HH. Table 3.5 includes as an additional explanatory variable the indices of distance between the capital content of products and the national endowment point. Tables 3.6, 3.7 and 3.8 examine survival probabilities separately by manufacturing industries, parts and components, and processed food. Table 3.9 shows whether the African Growth and Opportunity Act (AGOA) has influenced the survival performance of African exports in the United States. Tables 3.17 and 3.18 show results from discrete-time and continuous-time models that do *not* control for unobserved heterogeneity. Tables 3.19 and 3.20 report results for different tests of robustness of results.

To comment first on the main results, the overall entropy and the market entropy coefficients are both highly significant and negatively signed across all specifications (Tables 3.3 and 3.4). Increase in the value of entropy indicates de-

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23 When observation began in 1997, 39,634 export spells had commenced prior to 1997 (left-censored) for which it is impossible to ascertain the time-to-failure as we do not know how long the flow existed before we began to observe. Similarly, 49,982 export spells do not die when our observation ends in 2008 (right-censored), and it is unknown for how much longer they survive.

24 Chapter 19 of Greene (1997) and chapter 15 of Wooldridge (2002) explain the random effects probit estimator. If u_i is a group specific disturbance in the error term, $\epsilon_{it} = v_{it} + u_i$, the joint density of ϵ_{it} can be obtained by integrating u_i out of the joint density. After much algebraic manipulation, the final likelihood function lends itself to be computed using Gauss-Hermite quadrature.

creased concentration (or increased diversification) which is associated with decreased probability of export death. The industry entropy coefficient, however, is not statistically significant. This is in contrast to the evidence of Cadot et al. (2011). Using firm-level data from four Sub-Saharan African countries, they find that the existence of other firms exporting the same product to the same destination *raises* survival probability.[25] I find that the coefficient of industry entropy is sensitive to the aggregation of industries. When industries are defined more tightly – at the SITC 2-digit level instead of the way I do in Table 3.12 – I also find that high industry entropy is positively associated with higher probabilities of export death (that is, diversification at the industry level does not aid survival).

The coefficient of the measures of product sophistication (RFI and PRODY) are positive and highly significant across all three discrete-choice specifications in Tables 3.3 and 3.4. The greater the sophistication of exports, the higher the probability of export death, suggesting that not all countries are able to achieve a successful export of products that require a different mix of factor endowments than that supported by the economy.

Other variables that significantly affect survival include i) prior export experience; ii) the value of exports in the first year of a spell; and iii) relative real exchange rate. If there exists a prior export spell (of the same product from the same country) the survivor probability improves significantly on subsequent occasions. Similarly, the higher the initial value of the exports, the more likely is the probability that they last long. Initial value partly proxies for the trust, relationships, and networks already established between trading firms. And the negative coefficient on the relative real exchange rate suggests that depreciation of an ex-

25 Their conjecture is that this could be because of financial dependence. An increase in the share of a particular export product at the SITC 4-digit level (which increases the industry entropy) could reflect an increasing number of firms entering the export market. If this is a mark of proven success of that particular product, banks are likely to lend more easily, enhancing chances of survival. Cadot, Iacovone, Rauch & Pierola (2011) call this a positive synergy/network effect which should help those products that are dependent on external (bank) finance. They find support for this conjecture when they interact the network effect with a measure of financial dependence adapted from Rajan & Zingales (1998).

porting country's currency relative to the weighted average of all other competing countries aids survival.

Among the gravity variables, increased physical distance between trading countries increases the probability of an export dying. The coefficient of common language is barely significant for only one of the models (cloglog). Real GDP of the exporting country is a highly significant determinant of export survival, but real GDP per capita is not.

The coefficient of BTA is statistically significant in equations using the entropy as a measure of diversification. This suggests that having a BTA in place with the United States does help prolong export survival. The evidence on the unilateral trade preferences offered by the US is also clear. In Table 3.9, I include a dummy for the presence of trade preferences under AGOA. In the probit model, the coefficient of the AGOA variable is negative and significant at the 11 percent level and in the logit model it is significant at the 10 percent level, suggesting that AGOA trade preferences are weakly associated with reduced probability of death for exports.

In columns 3 and 4 of Table 3.9, I look at preferences applicable to the textile and clothing sector only. This category of manufactured exports from Africa saw one of the fastest growth rates in the 2000s. In both the probit and logit models, I find the coefficient on the dummy for AGOA in T&C products to be highly negative and significant, suggesting that unilateral trade preferences are associated with increased probability of survival of African exports from the apparel industry. However, until the end of 2004, world trade in textile and clothing was restrained by quotas. Because many Asian countries invested in Africa to avail themselves of the latter's under-utilized quotas, the positive effect on the export of textiles and clothing cannot be solely attributed to unilateral trade preferences granted by the United States.

In Table 3.5, I test the comparative advantage hypothesis. Products that embody "revealed" capital contents that are farther away from national endowment exhibit a higher probability of death. This is reflected in the high significance of coefficients of both measures of distance (Euclidean and Absolute) in the probit and logit models. The sign and significance of coefficients of all other variables are similar to those in Table 3.3, except for market entropy, BTA, and language.

So far, only the sign and significance of key covariates are reported, but it is not asserted *by how much* the probability of an export dying changes when covariates increase or decrease. This cannot be done just by looking at the probit and logit coefficients. Unlike an OLS model that assumes constant marginal effects, the partial effect of a unit increase in one of the covariates depends on all other covariates in non-linear models. This is more perilous when interaction terms are involved, as explained in the appendix to this chapter.

In Table 3.6, I examine the survival probabilities of products disaggregated by industry. As in the main results, higher entropy (increased diversification at the economy-wide level) is associated with increased survival of exports belonging to all industries except the Information and Communication Technology (ICT) industry, which also appears to benefit more from *within-industry* concentration of products. Market diversification is not an important determinant of survival, except for the textile and clothing and ICT industries. For the electrical industry, this coefficient is positive, suggesting that concentration of exports in fewer markets is associated with longer survival of exports.

On product sophistication, in the material-based and miscellaneous manufacturing (such as scientific and photographic equipment), higher sophistication is associated with lower survival. However, this is not the case in the electrical and ICT industries. In chemicals and the machinery/vehicles industries, there is no systematic association between product sophistication and survival probability.

Higher initial value, presence of a prior spell, and real GDP are all associated with increased survival probability, as shown in the main results of Table 3.3. While relative real exchange rate is not an important determinant for electrical, machinery/vehicles, and miscellaneous manufacturing, it aids survival significantly in textile/clothing, chemicals, material-based manufacturing and ICT industries. Longer bilateral distance lowers survival probability only in the heavy machinery/vehicles industries, which is as would be expected. The coefficient of Bilateral Trade Agreement (BTA) is not significant, except weakly, for the chemicals industry.

Table 3.3: Export Survival (RFI, 1998-2008)

	(1) Probit	(2) Logit	(3) Cloglog	(4) Probit	(5) Logit	(6) Cloglog
Entropy Overall	-.211***	-.337***	-.200***			
	(.019)	(.033)	(.023)			
Entropy Industry	.004	.015	.011			
	(.010)	(.017)	(.012)			
Entropy Market	-.056***	-.121***	-.083***			
	(.016)	(.028)	(.020)			
RFI	.147***	.272***	.218***	.145***	.270***	.217***
	(.009)	(.015)	(.012)	(.009)	(.015)	(.012)
Initial Value	-.145***	-.270***	-.219***	-.145***	-.269***	-.219***
	(.001)	(.003)	(.002)	(.001)	(.003)	(.002)
Multiple Spell	-.223***	-.416***	-.343***	-.224***	-.419***	-.345***
	(.006)	(.010)	(.008)	(.006)	(.010)	(.008)
Real GDP	-.095***	-.167***	-.128***	-.103***	-.182***	-.137***
	(.007)	(.013)	(.009)	(.007)	(.012)	(.009)
Real GDP Per Capita	.004	-.006	-.010	.005	-.004	-.010
	(.010)	(.018)	(.013)	(.010)	(.018)	(.013)
Normalized RER	-.001***	-.002***	-.001***	-.001***	-.002***	-.001***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
BTA	-.036**	-.066**	-.075***	-.022	-.042	-.063***
	(.017)	(.029)	(.022)	(.017)	(.029)	(.022)
Distance	.045***	.081***	.045**	.069***	.119***	.063***
	(.015)	(.027)	(.019)	(.016)	(.028)	(.020)
Language	.007	.031	.048*	.026	.058	.063**
	(.022)	(.039)	(.027)	(.022)	(.039)	(.027)
HH Overall				-.502***	-.818***	-.475***
				(.046)	(.080)	(.056)
HH Industry				-.004	.025	.009
				(.045)	(.077)	(.053)
HH Market				-.389***	-.739***	-.441***
				(.065)	(.114)	(.079)
No.	423251	423251	423251	423251	423251	423251

Note 1: standard errors in parenthesis

Note 2: statistical significance indicated as * for p<0.1, ** for p<0.05, and *** for p<0.01

Note 3: models include random effects at the country-industry level

Table 3.4: Export Survival (PRODY, 1998-2008)

	(1) Probit	(2) Logit	(3) Cloglog	(4) Probit	(5) Logit	(6) Cloglog
Entropy Overall	-.204***	-.324***	-.190***			
	(.018)	(.032)	(.023)			
Entropy Industry	-.001	.006	.005			
	(.010)	(.017)	(.012)			
Entropy Market	-.054***	-.121***	-.083***			
	(.015)	(.027)	(.019)			
PRODY	.064***	.122***	.100***	.064***	.121***	.100***
	(.004)	(.007)	(.006)	(.004)	(.007)	(.006)
Initial Value	-.140***	-.261***	-.213***	-.140***	-.261***	-.212***
	(.001)	(.002)	(.002)	(.001)	(.002)	(.002)
Multiple Spell	-.219***	-.407***	-.337***	-.220***	-.410***	-.339***
	(.006)	(.010)	(.008)	(.006)	(.010)	(.008)
Real GDP	-.093***	-.163***	-.124***	-.102***	-.179***	-.134***
	(.007)	(.013)	(.009)	(.007)	(.012)	(.009)
Real GDP Per Capita	.003	-.010	-.013	.003	-.009	-.013
	(.010)	(.018)	(.013)	(.010)	(.018)	(.013)
Normalized RER	-.001***	-.002***	-.001***	-.001***	-.002***	-.001***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
BTA	-.041**	-.075***	-.082***	-.027	-.050*	-.069***
	(.016)	(.028)	(.021)	(.016)	(.029)	(.021)
Distance	.045***	.080***	.043**	.069***	.119***	.061***
	(.015)	(.026)	(.019)	(.016)	(.028)	(.019)
Language	.002	.023	.042	.020	.049	.056**
	(.022)	(.038)	(.027)	(.022)	(.038)	(.027)
HH Overall				-.483***	-.781***	-.450***
				(.045)	(.078)	(.054)
HH Industry				-.014	.007	.002
				(.043)	(.075)	(.052)
HH Market				-.391***	-.750***	-.442***
				(.063)	(.111)	(.076)
No.	447812	447812	447812	447812	447812	447812

Note 1: standard errors in parenthesis

Note 2: statistical significance indicated as * for p<0.1, ** for p<0.05, and *** for p<0.01

Note 3: models include random effects at the country-industry level

Table 3.5: Export Survival (Factor Endowment, 1998-2008)

	(1) Euc. Distance (ED)	(2) ED*GDP	(3) Abs. Distance (AD)	(4) AD*GDP
	Probit			
Euc. Distance	.053***	.111***		
	(.007)	(.040)		
Entropy Overall	-.345***	-.342***	-.346***	-.344***
	(.023)	(.023)	(.023)	(.023)
Entropy Industry	-.016	-.016	-.016	-.016
	(.011)	(.011)	(.011)	(.011)
Entropy Market	.063***	.061***	.063***	.061***
	(.018)	(.018)	(.018)	(.018)
RFI	.200***	.191***	.200***	.192***
	(.010)	(.012)	(.010)	(.012)
Initial Value	-.146***	-.146***	-.146***	-.146***
	(.002)	(.002)	(.002)	(.002)
Multiple Spell	-.206***	-.206***	-.206***	-.206***
	(.006)	(.006)	(.006)	(.006)
Real GDP	-.102***	-.101***	-.102***	-.101***
	(.008)	(.008)	(.008)	(.008)
Real GDP Per Capita	.112***	.127***	.111***	.123***
	(.012)	(.016)	(.012)	(.016)
Normalized RER	-.002***	-.002***	-.002***	-.002***
	(.000)	(.000)	(.000)	(.000)
BTA	.030	.030	.030	.030
	(.020)	(.020)	(.020)	(.020)
Distance	.039**	.039**	.040**	.040**
	(.017)	(.017)	(.017)	(.017)
Language	-.041*	-.039*	-.042*	-.040*
	(.023)	(.023)	(.023)	(.023)
Dist*GDP per cap.		-.008		
		(.006)		
Abs. Distance			.038***	.074**
			(.005)	(.029)
Dist*GDP per cap.				-.005
				(.004)
No.	362329	362329	362329	362329

Note 1: standard errors in parenthesis

Note 2: statistical significance indicated as * for p<0.1, ** for p<0.05, and *** for p<0.01

Note 3: models include random effects at the country-industry level

Table 3.6: Export Survival (Manufactured Exports by Sector, 1998-2008)

	(1) Miscellaneous	(2) Material-based	(3) Textile/Clothing	(4) Chemicals	(5) Machinery/Vehicles	(6) Electricals	(7) ICT
Entropy Overall	-.254***	-.170***	-.302***	-.253***	-.149***	-.209**	-.370***
	(.036)	(.045)	(.049)	(.060)	(.048)	(.083)	(.053)
Entropy Industry	.090***	.002	-.032	.064	.014	.114*	-.037
	(.023)	(.024)	(.035)	(.046)	(.018)	(.067)	(.041)
Entropy Market	-.002	.001	-.122***	-.003	-.089**	.003	.092**
	(.031)	(.038)	(.038)	(.048)	(.042)	(.072)	(.042)
RFI	.275***	.103***	.204***	.002	-.079	.060	-.376***
	(.019)	(.021)	(.016)	(.027)	(.050)	(.084)	(.097)
Initial Value	-.158***	-.146***	-.149***	-.124***	-.127***	-.139***	-.152***
	(.004)	(.003)	(.003)	(.004)	(.004)	(.008)	(.007)
Multiple Spell	-.225***	-.212***	-.173***	-.257***	-.285***	-.275***	-.243***
	(.014)	(.014)	(.012)	(.018)	(.016)	(.031)	(.031)
Real GDP	-.110***	-.121***	-.050*	-.110***	-.116***	-.176***	-.104***
	(.013)	(.016)	(.027)	(.021)	(.017)	(.029)	(.014)
Normalized RER	-.000	-.001**	-.003***	-.002***	-.001	.000	-.000
	(.000)	(.000)	(.000)	(.001)	(.001)	(.001)	(.001)
BTA	-.025	-.120***	.009	-.097*	-.058	.040	-.111
	(.039)	(.042)	(.033)	(.057)	(.048)	(.079)	(.071)
Distance	.008	-.006	.021	.043	.034	.097*	.031
	(.028)	(.033)	(.055)	(.043)	(.036)	(.058)	(.032)
Language	-.047	.000	-.074	-.064	.015	.139*	.077*
	(.040)	(.047)	(.082)	(.063)	(.052)	(.084)	(.045)
No.	77290	70990	114855	42635	51038	15238	14675

Note 1: standard errors in parenthesis

Note 2: statistical significance indicated as * for p<0.1, ** for p<0.05, and *** for p<0.01

Note 3: models include random effects at the country-industry level

Table 3.7: Export Survival (Parts and Components, 1998-2008)

	(1) All	(2) Parts	(3) Non-Parts	(4) All	(5) Parts	(6) Non-Parts
		Probit			Logit	
Entropy Overall	-.220***	-.260***	-.217***	-.350***	-.434***	-.346***
	(.021)	(.032)	(.023)	(.036)	(.055)	(.040)
Entropy Industry	-.008	-.020	-.009	-.004	-.029	-.006
	(.011)	(.014)	(.012)	(.018)	(.025)	(.021)
Entropy Market	-.064***	.051*	-.071***	-.141***	.084*	-.151***
	(.017)	(.027)	(.019)	(.031)	(.047)	(.034)
Parts	1.045***			1.785***		
	(.159)			(.282)		
RFI	.208***	.074*	.194***	.383***	.159**	.357***
	(.009)	(.041)	(.010)	(.017)	(.073)	(.017)
Parts*RFI	-.302***			-.517***		
	(.039)			(.069)		
Initial Value	-.144***	-.160***	-.142***	-.267***	-.300***	-.262***
	(.001)	(.004)	(.002)	(.003)	(.008)	(.003)
Multiple Spell	-.221***	-.279***	-.213***	-.410***	-.509***	-.397***
	(.006)	(.015)	(.007)	(.011)	(.027)	(.012)
Real GDP	-.098***	-.141***	-.083***	-.174***	-.249***	-.146***
	(.008)	(.010)	(.009)	(.015)	(.017)	(.016)
Real GDP Per Capita	.001	.005	.012	-.015	.011	.004
	(.012)	(.014)	(.013)	(.021)	(.025)	(.023)
Normalized RER	-.001***	-.001	-.001***	-.002***	-.001	-.002***
	(.000)	(.001)	(.000)	(.000)	(.001)	(.000)
BTA	-.038**	-.093**	-.034*	-.067**	-.153**	-.066*
	(.018)	(.038)	(.020)	(.031)	(.066)	(.034)
Distance	.042**	.017	.035*	.075**	.029	.065*
	(.017)	(.021)	(.019)	(.031)	(.037)	(.034)
Language	.007	.047	.008	.033	.091*	.035
	(.025)	(.030)	(.028)	(.045)	(.052)	(.049)
No.	386721	63534	323187	386721	63534	323187

Note 1: standard errors in parenthesis

Note 2: statistical significance indicated as * for p<0.1, ** for p<0.05, and *** for p<0.01

Note 3: models include random effects at the country-industry level

Table 3.8: Export Survival (Processed Food, 1998-2008)

	(1) All Food	(2) Processed	(3) Non-Processed	(4) All Food	(5) Processed	(6) Non-Processed
	Probit			Logit		
Entropy Overall	-.095***	-.112**	-.083**	-.155***	-.177**	-.138**
	(.035)	(.047)	(.039)	(.059)	(.081)	(.068)
Entropy Industry	-.027	.013	-.036	-.050	.016	-.064
	(.022)	(.034)	(.024)	(.038)	(.058)	(.042)
Entropy Market	-.048*	-.067*	-.023	-.084*	-.121*	-.041
	(.029)	(.039)	(.033)	(.050)	(.067)	(.058)
Processed Food	.167			.283		
	(.106)			(.188)		
RFI	.041**	-.033	.041**	.076**	-.048	.075**
	(.018)	(.023)	(.019)	(.033)	(.041)	(.033)
Processed*RFI	-.070**			-.119**		
	(.029)			(.052)		
Initial Value	-.166***	-.174***	-.157***	-.305***	-.322***	-.286***
	(.004)	(.005)	(.005)	(.007)	(.010)	(.009)
Multiple Spell	-.234***	-.232***	-.241***	-.431***	-.433***	-.433***
	(.015)	(.020)	(.022)	(.026)	(.035)	(.038)
Real GDP	-.064***	-.062***	-.064***	-.111***	-.106***	-.110***
	(.011)	(.015)	(.012)	(.019)	(.025)	(.020)
Real GDP Per Capita	.022	.008	.037**	.036	.011	.061**
	(.016)	(.022)	(.016)	(.027)	(.038)	(.028)
Normalized RER	-.000	-.001	.000	-.000	-.001	.000
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)
BTA	-.058	-.063	-.090	-.106	-.116	-.153
	(.038)	(.049)	(.055)	(.067)	(.087)	(.097)
Distance	.041***	.047***	.032**	.071***	.085***	.053**
	(.013)	(.018)	(.015)	(.023)	(.030)	(.025)
Language	-.019	.039	-.050	-.032	.069	-.090
	(.032)	(.042)	(.033)	(.054)	(.071)	(.057)
No.	64866	36530	28336	64866	36530	28336

Note 1: standard errors in parenthesis

Note 2: statistical significance indicated as * for p<0.1, ** for p<0.05, and *** for p<0.01

Note 3: models include random effects at the country-industry level

Table 3.9: Export Survival (Trade Preferences, 1998-2008)

	(1)	(2)	(3)	(4)
	Probit	Logit	Probit	Logit
	All Products		Textile and Clothing	
Entropy Overall	-.214***	-.342***	-.311***	-.506***
	(.019)	(.033)	(.049)	(.086)
Entropy Industry	.005	.016	-.015	.004
	(.010)	(.017)	(.035)	(.061)
Entropy Market	-.055***	-.119***	-.120***	-.237***
	(.016)	(.028)	(.038)	(.067)
RFI	.147***	.272***	.205***	.378***
	(.009)	(.015)	(.016)	(.028)
Initial Value	-.146***	-.270***	-.150***	-.275***
	(.001)	(.003)	(.003)	(.005)
Multiple Spell	-.222***	-.414***	-.168***	-.322***
	(.006)	(.010)	(.012)	(.021)
Real GDP	-.096***	-.168***	-.050*	-.095**
	(.007)	(.013)	(.027)	(.048)
Real GDP Per Capita	.002	-.010	-.026	-.083
	(.010)	(.018)	(.036)	(.065)
Normalized RER	-.001***	-.002***	-.003***	-.005***
	(.000)	(.000)	(.000)	(.001)
BTA	-.036**	-.067**	.011	.011
	(.017)	(.029)	(.033)	(.060)
AGOA	**-.028**	**-.053***		
	(.017)	(.030)		
Distance	.048***	.087***	.034	.054
	(.015)	(.027)	(.056)	(.098)
Language	.012	.041	-.045	-.041
	(.022)	(.039)	(.083)	(.145)
AGOA TC			**-.118*****	**-.213*****
			(.038)	(.065)
No.	423251	423251	114855	114855

Note 1: standard errors in parenthesis

Note 2: statistical significance indicated as * for p<0.1, ** for p<0.05, and *** for p<0.01

Note 3: models include random effects at the country-industry level

Table 3.7 parses manufacturing data another way. I classify manufactured exports as belonging to either the category of parts and components or finished products. From column 1, it is clear that parts and components, on average, have a lower probability of survival. The interaction term between parts and RFI, however, is negative and suggests that the probability of death for sophisticated products is lower if the product happens to be a part or a component. One possible reason is that the higher sophistication reflected by RFI (or PRODY) is deceptive in the case of fragmentation-friendly industries: the export could just embody value-added from the final assembly of (high-value) intermediate innards made elsewhere.[26]

While parts and components behave similarly to non-parts and components in terms of variables such as overall diversification, sophistication (RFI), GDP, initial value, and presence of a prior spell, coefficients of some important variables between the two subgroups stand out. For parts and components, the coefficient on market entropy is the opposite of that seen for non-parts. This indicates that concentration of exports of parts to a narrow range of destinations helps increase the probability of survival, possibly through synergy and informational externalities emanating from peer exports to those few markets. Coefficients of bilateral distance and relative real exchange rate are both insignificant, suggesting that they play little or no role in determining how long the export of parts and components lasts, unlike their influence on non-parts. These differences would lead us to infer, as does Obashi (2010), that the stability of trade in parts and components is driven by a different set of covariates.[27]

In Table 3.8, I group non-fuel primary products into processed and non-processed food categories. The two categories do not behave differently, except on the coefficient of RFI: increase in the sophistication of processed food is *not* associated with decreased probability of survival. Unlike parts and components, both processed and unprocessed food stuffs are highly sensitive to bilateral distance. This is not surprising because food items are perishable. Food items (both

26 Koopman et al. (2008) estimate the foreign content in China's exports to be about 50 percent overall, and 80 percent in sophisticated products like electronic devices. In 2006/07, nearly 75 percent of components imported for machinery and transport equipment (SITC 7) by China were from the rest of East Asia (Athukorala & Menon 2010). In the iPhone example mentioned earlier, while the product is recorded as a sophisticated export from China, imported parts and components from four different countries account for 70 percent of the final cost.

27 Obashi (2010), however, focuses only on machinery exports (SITC 7) within selected Asian countries. He also uses the Cox semi-parametric method which Hess & Persson (2011) have argued to be unsuitable for analyzing trade data.

processed and unprocessed) are also found not to be sensitive to movements in the relative exchange rate.

Before concluding this section, I show in Tables 3.17 and 3.18 results from discrete-time and continuous-time models, respectively, that do *not* control for unobserved heterogeneity. Standard errors are clustered by exporting country. The coefficients in Table 3.17 bear the same sign and significance as in Table 3.3 for many important variables such as overall and industry entropy, RFI, initial value of exports, multiple spell, and GDP. However, neither the coefficient of market entropy nor coefficients of bilateral distance, language, and the relative real exchange rate are significant. Curiously, real GDP per capita is positively significant, indicating that exports from countries with high income per capita do not last long when all other variables are controlled for. This is counter-intuitive and is different from the results in models that control for unobserved heterogeneity.

Table 3.18 shows results for Cox PH models. As explained earlier, continuous-time is a flawed set-up for studying trade duration, but given its widespread use in the extant literature, I estimate the relative risks (hazard ratios) for all the main variables of interest to gauge the extent of bias. Compared with the main results, this specification that does not control for unobserved heterogeneity and assumes proportional hazard also confirms that many variables are similarly significant (coefficients above unity indicate increased hazard and those below unity reduced hazard).[28] However, higher income per capita and the presence of the BTA *increase* the probability of export death; bilateral distance and language have no significance, and the coefficient of market entropy has a different sign. These results, as presented in Tables 3.17 and 3.18, show that inferences differ depending on whether unobserved heterogeneity is controlled for or not.

28 Note that unlike in discrete-time models where each export spell transforms itself into a number of observations equaling its duration in years, in a continuous-time model, each observation is an export spell, so the number of observations is fewer.

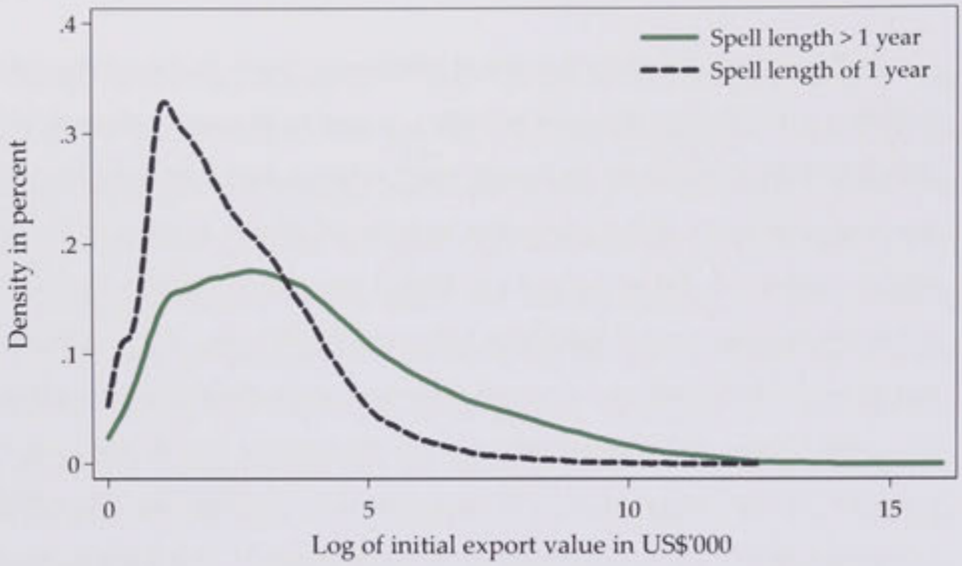
3.8 ROBUSTNESS

In this section, I conduct two sets of robustness checks on the results reported in Table 3.3. The first set of results in Table 3.19 uses an alternative measure of overall export diversification, the Zipf coefficient[29] which is explained in Figure 3.6. The sign and significance of this alternative measure are similar to those of the overall entropy measure in Tables 3.3 and 3.4. Here, I also define product sophistication as just one of three discrete categories, following Rauch (1999). The results suggest that differentiated products – assumed to be more sophisticated than the other two categories – have a lower probability of death. However, as already shown in Table 3.3, when sophistication is measured by a continuous variable like RFI or PRODY, increased sophistication *increases* the probability of death. This finding, which is consistent with Besedes & Prusa (2006*b*), suggests that the association of product sophistication with export survival is sensitive to aggregation bias.

In the second set of robustness tests I ask whether the results change when small values of initial exports are dropped. Column 2 in Table 3.20 shows results when initial export values below US$10,000 are excluded. Compared with the baseline estimates in Column 1 of the same table, the sign and significance of all variables stay unchanged except three: the probability of survival for higher-valued exports increase if the exporting nation real GDP per person is higher; but the coefficients of BTA and market entropy no longer are. In column 3, I only include export spells valued at US$100,000 or more. The same pattern as in Column 2 is repeated, except that the market entropy coefficient is now positive and significant. Results in these two columns suggest that as export values increase, concentration in fewer markets appears to prolong the survival of exports. In other words, higher-valued exports are more sensitive to informational extenalities derived from specific markets. This is also in line with the model of Rauch (1999) where high-

29 This coefficient is obtained by regressing the log (of base 10) of the share in total exports against the log of rank of the top 30 exports of each country for each year. This is named after the linguist George Kingsley Zipf. Technically, Zipf's law requires the coefficient to be -1. In my data set, the mean Zipf coefficient across the six regions varies between -0.9 (in South Asia and Eastern Europe) to a high of -1.73 in Sub-Saharan Africa.

Figure 3.4: Kernel Densities of Export Spells



Source: Computed by author from trade data in COMTRADE

valued shipments reflect more established ties between importers and exporters, and they tend to be confined to a few big sourcers in select countries.

Next, I test whether results are sensitive to the choice of the length of export spells. Spells lasting just one year are a dominant category (if not the majority) in all samples whether at the country-product or firm-level. Most papers explain very short spells as symptomatic of firm failure, or uncertainty and mis-match between suppliers and buyers. Murakozy & Bekes (2009) have shown that temporary trade (short export spells) is driven by different forces than permanent trade.[30] Figure 3.4 shows Kernel densities of export values in the US data set where the volume of transient trade (spell of only one year) is smaller than longer-living trade.

To explore whether the coefficients of the determinants of export survival are different, column 4 of Table 3.20 reports results when the regression is run only on export spells that are at least two years long. This set of results, when compared

30 Besedes & Prusa (2010*a*) cite the example of Brazil where in 1999 the government implemented a simplified export procedure for goods valued less than $10,000 through postal or logistics operators. These low-valued exports tend to survive for very short durations.

with estimates in column 1, shows that the overall and industry entropy are robust to alternative lengths of export spells. The market entropy coefficient, however, is no longer significant, indicating that as exports get traction in overseas markets after surviving the first few years, a country's focus on a narrow range of markets no longer becomes a concern. This conjecture is also buttressed by the fact that the coefficient of the multiple spell variable is not significant. When higher-valued export spells lasting two years or longer are analyzed, the fact that the same export spell existed before does not positively affect the chances of survival the second time. In such cases we can infer that the likelihood of death of such products is because of the product's intrinsic risks, not a lack of exporter experience.

In column 5 of Table 3.20, I test for the possibility that an export record that is kept in years *n* and *n+2* but not in *n+1* is a measurement error. Assuming, therefore, that two spells of identical product and country separated by only one year are not distinct, I adjust trade data in a way that disregards such gaps of one year (to restore an otherwise continuous export series). This reduces the number of spells of duration modestly, and increases the median export spell to two years. This change, however, does not affect the significance of most variables in the original model except the coefficients of market entropy and BTA which are significant and positive (compare column 5 with column 1 in Table 3.20). This suggests that export diversification by destination and the availability of trade preferences matter more when countries are seeking a footing in world markets and have fragile export lines that are yet to establish durable ties with importers.

In sum, five of the explanatory variables are consistently associated with increased probability of export survival on average: overall diversification, product sophistication in line with comparative advantage, high value of initial exports, competitive real exchange rate, and GDP of the exporting country. It has to be noted that a majority of developing countries that have posted high export growth between 1998 and 2008 tend to have a diversified export base (Figure 3.7).

Variables with more ambiguous results are as follows. Concentration (not diversification) aids survival at the industry-level for some industries (such as ICT). The evidence on the concentration of export destinations is mixed. BTAs and unilateral trade preferences like AGOA are generally helpful to export survival, but not under scenarios where export spells are longer. Prior export experience is also generally helpful to exporters starting small, but not to high-valued exports. And unlike high GDP which proxies for the quality of infrastructure and economies of scale in the exporting country that aids survival, GDP per capita either has no impact, or affects survival probability negatively. In only one instance (export of machinery and road vehicles) is higher GDP per capita associated with reduced probability of export death.

3.9 CONCLUSION

This paper sought to explain the cross-national differences in the survival of exports through characteristics embodied in products, industries, and countries. It improves upon a conventional econometric technique by using data-intensive discrete-time models that control for unobserved heterogeneity at the country-industry level. The literature on trade duration analysis almost exclusively uses the continuous-time (Cox) proportional hazard model. I formally test the assumption of proportional hazards and reject it. I show the importance of the choice of estimation technique by contrasting the differing statistical inferences drawn from continuous-time and discrete-time models. Using an improved methodology, this paper contributes to the emerging literature on export survival as follows.

First, I use new measures of product sophistication to test whether survival chances vary by sophistication and distance from a country's "point of comparative advantage." I find the result to be at odds with earlier studies that grouped products into only three categories of implied sophistication. My results lend credence to the hypothesis that countries that attempt to produce goods that are much more sophisticated than what their capital endowments support could experience a higher rate of exit from foreign markets than those that rely on products that are better aligned with comparative advantage. I show this to be the case by computing Euclidean distances between each product's factor content and the country's point of comparative advantage.

Second, I examine the role of information externality in export activity, and find that exports from countries with a narrow product base do not survive as long as countries that are more diversified in the range of products they manufacture. However, the evidence on the impact of diversification by export destination, or within industries, is mixed. When industries are grouped by broad sectoral levels, higher concentration within industry is not systematically associated with survival probability, except in a few manufacturing industries like ICT. When industries are defined at a more dis-aggregated level (SITC 2-digit), however, intra-industry concentration is associated with *decreased* probability of export death. This points towards a different kind of externality – from synergy and networks – among products at the intra-industry level. This latter finding at the country-product level needs to be probed further with firm-level data as Cadot, Iacovone, Rauch & Pierola (2011) have done, offering a conjecture on how industry-level concentration could aid survival by facilitating access to finance for exporting firms.

Third, I find that parts and components are less sensitive to bilateral distance and the relative real exchange rate; and unlike the survival of finished exports, concentration of destination markets appears to aid survival of parts and components. In contrast, both processed and unprocessed food-stuffs are highly sensitive to bilateral distance because of their perishability. In fact, there is little difference in the determinants of survival of processed and unprocessed food, except that the sophistication of processed food is not associated with decreased probability of survival, whereas that of unprocessed food is.

Fourth, the extent to which unilateral trade preferences and bilateral trade agreements, or movements in real exchange rates help export growth is an ongoing issue of debate in development policy. This paper shows that bilateral trade agreements and relative real exchange rate policy choices are not trivial; they significantly affect the survival probabilities of exports particularly from developing countries that are new to the world market and are seeking a foothold.

APPENDIX

3.A INTERPRETING AN INTERACTION EFFECT

The partial effect of one particular covariate in probit and logit models depends upon *all* other covariates, evaluated at specific points (their mean, for example). From equation 3.6, a small increase in the value of the jth covariate affects the probability of an event occurring by $\phi(\mathbf{Xb}) * b_j$ where $\phi(.)$ is the probability density function derived from the cumulative standard normal $\Phi(.)$. Because the relationship between the covariates and the dependent variable is not linear, the coefficient β_j is not constant.

$$\frac{\partial \Pr(Y=1)}{\partial X_j} = \frac{\partial \Phi(\mathbf{Xb})}{\partial X_j} = \phi(\mathbf{Xb}) * b_j \tag{3.A.1}$$

The interpretation of coefficients on interaction terms is even less straightforward. In linear regression, the sign of the interaction term is obvious, and the significance of the coefficient can be t-tested. This is not so in non-linear regression models.[31] In this paper, I ask whether products deemed sophisticated (Soph) have different survival rates depending on whether they are a part/component (Part) or a finished good. This distinction is important because of the rising importance of production networks in world trade. Because the coefficients and standard errors for the interaction terms that appear in regression outputs do not tell us definitively about the sign, magnitude, and significance of the interaction effect, they have to be calculated separately for specific values of the variables that interest us.

31 Norton et al. (2004) reviewed 72 articles in 13 economics journals published between 1980 and 1999 that used interaction terms in non-linear models to find that *none* interpreted the coefficient on the interaction term correctly.

In fact, an interaction term with a positive coefficient could still lead to an effect that is negative.

$$
\begin{aligned}
\frac{\partial \Pr(Y=1)}{\partial \mathbf{Soph}} &= \frac{\partial \Phi(\mathbf{Xb} + \mathbf{b_S Soph} + \mathbf{b_F Part} + \mathbf{b_{SF} Soph} * \mathbf{Part})}{\partial \mathbf{Soph}} \\
&= (b_S + b_{SF}\mathbf{Part})\Phi'(.) \\
\frac{\partial^2 \Pr(Y=1)}{\partial \mathbf{Soph}\, \partial \mathbf{Parts}} &= (\mathbf{b_{SF}})\Phi') \\
&+ (b_F + b_{SF}\mathbf{Soph})(b_S + b_{SF}\mathbf{Part})\Phi''(.) \qquad (3.A.2)
\end{aligned}
$$

Using the formulation in equation 3.A.2 for probit results, I test the significance of the interaction term between sophistication and fragmentation at the mean values of all continuous covariates (that is, entropy indices, distance, initial value, GDP and exchange rate) for countries not party to a bilateral trade agreement with the United States. Sophistication, measured by standardized RFI, is a continuous variable and Parts is a dummy. Interaction between the two is the discrete difference of the single derivative (with respect to sophistication), as explained in Norton et al. (2004).

$$
\begin{aligned}
\frac{\frac{\Delta \partial \Phi(.)}{\partial \mathbf{Soph}}}{\triangle \mathbf{Part}} &= (b_s + b_{sf})\Phi'\{((b_s + b_{sf})\mathbf{Soph} + \mathbf{Part} + \mathbf{X}b)\} \\
&- b_s \Phi'(b_s \mathbf{Soph} + \mathbf{X}b) \qquad (3.A.3)
\end{aligned}
$$

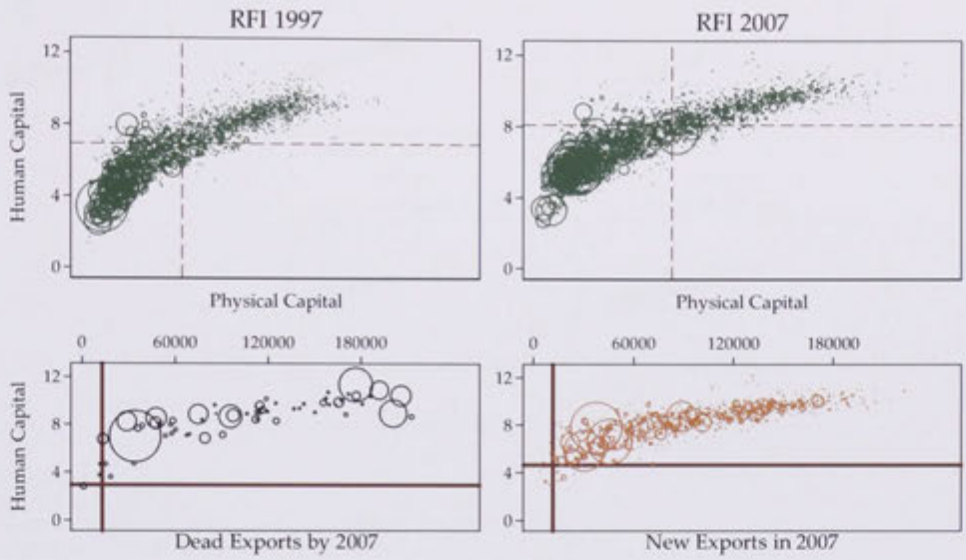
This results in a negative and highly significant coefficient for the interaction term that shows that the probability of export death for sophisticated products is lower if they are a part/component (Table 3.10).

Table 3.10: Statistical Significance of an Interaction Effect

Interaction Term	Coefficient	St. Error	z	P > |z|	95% Confidence Interval
Parts*RFI	-0.0498	0.019	-2.67	0.008	-0.086 to -0.013

3.B FIGURES AND TABLES

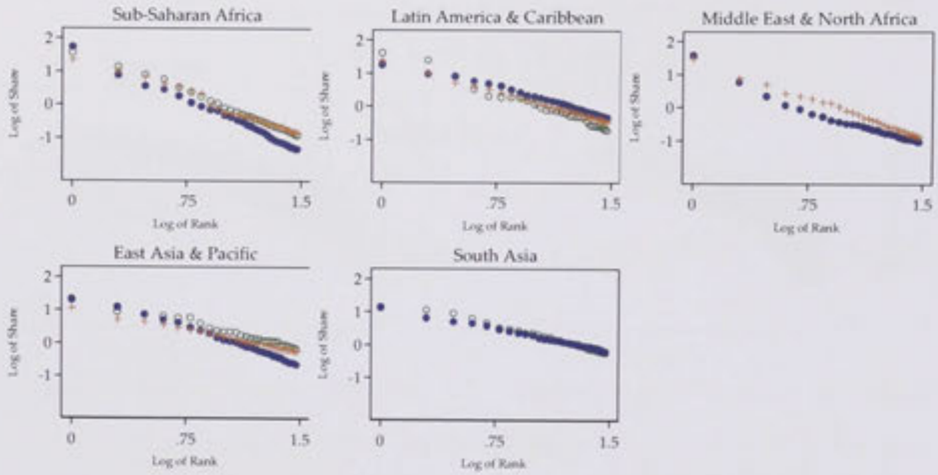
Figure 3.5: Illustration of Export Sophistication and Survival



Source: Computed by author using trade data from COMTRADE
and RFI data from Shirotori et al. (2010)

The first two graphs in the top panel plot exports from Pakistan with their human capital content on the x-axis and physical capital content on the y-axis. The bubble size represents the US dollar amount of exports in 1997 and 2007. The dashed reference lines are median values of revealed human and physical capital for exports (above US$10,000). In both time periods, Pakistan biggest export earners utilized capital way below utilized by median exports on either dimension. In 2007, the median values of capital content increased, and some major exports used more than the median capital. The two graphs on the bottom panel reflect exports relative to the national endowment points. Between 1997 and 2007, Pakistan's human capital increased from 2.97 to 4.66, but physical capital (per worker) dropped from 12838 to 11614.5. There are several big export earners that existed in 1997 but not in 2007 that embody much more capital than the national endowment. At the same time, the majority of "new" exports that were active in 2007, but not a decade earlier, are moderately capital-intensive.

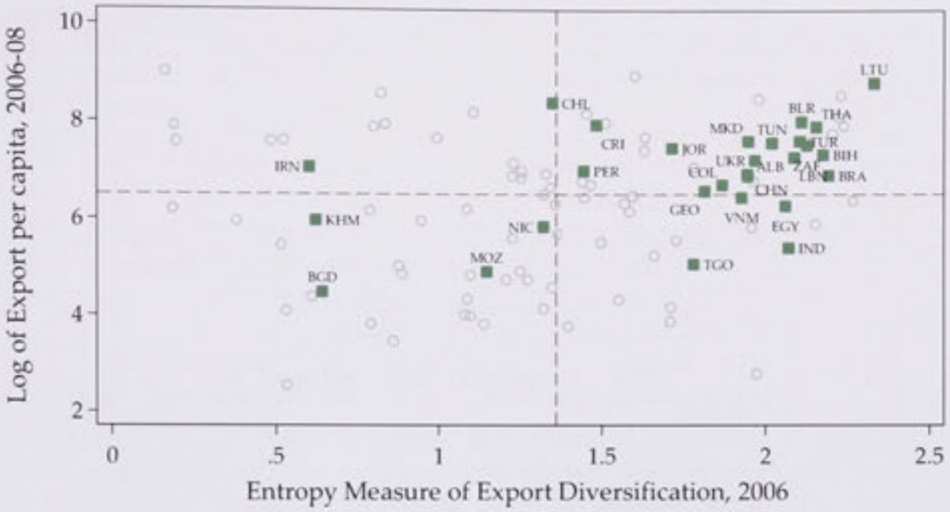
Figure 3.6: Relationship Between Export Rank and Shares



Source: Computed by author using COMTRADE
Note 1: Hollow circles (in green) indicate low-income countries;
Filled circles (in navy) indicate lower-middle income countries;
Crosses (in orange) indicate upper-middle income countries

Each year, the shares of the top exports at the SITC 4-digit level are ranked from 1 to 30 by value. I then compute the Zipf coefficient (of overall export diversification) for each country by regressing the log (of base 10) of the export shares on the log of rank. The flatter the regression fit, the more diversified is the export portfolio. A perfect compliance with Zipf's law follows power law, and produces a regression coefficient of -1 (a straight line) where the second-ranked export is half the value of the first-ranked export, the third-ranked export is one-third the value of the first-ranked export and so on. The countries in Sub-Saharan Africa, Latin America and the Middle East appear to have the lowest power law coefficient, that is, sharper regression fits and higher concentration of the top exports. In contrast, Eastern European countries appear to have the most diversified export portfolios, followed by East and South Asia.

Figure 3.7: Diversification and Export Performance



Source: WDI
Note 1: Entropy computed by author from data in COMTRADE
Note 2: 28 high growers named

There is a noticeable correlation between the export performance of countries and the diversification of their export base. I plot the Entropy measure of overall export diversification (in 2006) against the log of export per capita in 2006-08. Twenty-eight developing countries (listed in Table 3.15) that I select as having met the following criteria of high export performance between 1997-98 and 2007-08 are highlighted. First, total merchandise exports per person grew at an average annual compound rate of at least 10 percent during the 10-year period. Second, non-fuel exports of countries achieved an average growth of 10 percent per annum. And third, countries' share of manufactured exports relative to GDP did not fall during the period. The majority of the high export performers appear in the "preferable" first quadrant with above-median export-per-capita from a well diversified export base. The only country in the fourth quadrant – Iran – earns above average export income, but in an economy that is less diversified.

Table 3.11: Time-to-Death of Exports to the US, 1997-2008

Region	*Spell Length (Year)*		No. of spells	*KM Survival Rate*		
	Mean	Median		Year 1	Year 6	Year 11
East Asia and Pacific	4.492	1	32361	0.640	0.402	0.355
Europe and Central Asia	2.705	1	28061	0.494	0.212	0.159
Latin America	3.353	1	61000	0.541	0.269	0.222
Middle East and N. Africa	2.526	1	11136	0.471	0.194	0.157
South Asia	4.017	1	14869	0.607	0.356	0.315
Sub-Saharan Africa	2.212	1	22661	0.405	0.149	0.111
World	*3.315*	*1*	*170088*	*0.535*	*0.274*	*0.229*

Note: KM Survival Rate is the probability of survival beyond the specified year

Table 3.12: Industries Classified by SITC

	Industry	SITC
1	Miscellaneous manufacturing	8, net of 84
2	Material-based manufacturing	6, net of 65
3	Textile and Clothing	65, 84
4	Chemicals	5
5	Machinery	7, net of 75, 76, 77, 78
6	Electricals	77, net of 772 and 776
7	ICT	75, 76, 772 776
8	Road vehicles	78
9	Food, beverages, live animals, tobacco	0, 1, 4, 22, net of 43, 121
10	Agricultural raw material	121, 2, net of 22
11	Ores and metals	27, 28, 68
12	Fuel	3

Note: Section (1-digit), Division (2-digit), Group (3-digit), Product (4-digit)

Table 3.13: Test of the Proportional Hazards Assumption

Concept	Explanatory Variable	Rho	Chi-Squared	p-value
Diversification and sophistication	Entropy (Overall)	-0.049	11521.92	0.000
	Entropy (Products)	-0.033	2190.1	0.000
	Entropy (Markets)	0.041	7696.76	0.000
	RFI	-0.035	3360.67	0.000
Export experience and competitiveness	Initial value	-0.019	1641.54	0.000
	Multiple spell	0.003	19.2	0.000
	Real GDP	-0.039	6908.51	0.000
	Real GDP per capita	0.055	14292.04	0.000
	Relative real exchange rate	0.039	4007.79	0.000
	Bilateral Trade Agreement	-0.030	979.09	0.000
Trade and search costs	Distance	-0.042	6377.37	0.000
	Contiguity	0.044	9328.63	0.000
	Common language	-0.003	26.94	0.000
	Colony	0.047	8761.58	0.000
	Global test		*22355.64*	*0.000*

Table 3.14: Description and Source of Variables

Variable	Description	Source
(Log of) RFI	Revealed Factor Intensity index of each product at the HS 6-digit level. The index is an equal-weighted average of the standardized versions of the Revealed Human Capital Intensity index and the Revealed Physical Capital Intensity index which are computed as a sum of human or physical capital endowments weighted by the ratio of the share of the product in a country's export basket to the sum of shares of the product in the overall export basket of all other countries. The weights add up to 1. The human capital endowment is estimated by the average years of schooling. The physical capital stock is estimated by the perpetual inventory method. Both the indices are standardized using the min-max rule to convert them onto a scale of 0 to 100 before being averaged to compute a single Revealed Factor Intensity index. The final index is then expressed in logarithms.	Standardized by author from RFI data computed by UNCTAD
(Log of) PRODY	The income content of each product at the HS 6-digit level. The index is a weighted sum of the average GDP per capita income of ten groups of roughly 15 countries each weighted by the ratio of the share of the product in a group's export basket to the sum of shares of the product in the overall export basket of all income groups. The weights sum to 1 and are a variant of the revealed comparative advantage (RCA) index.	Computed by author from COMTRADE data, combining methods of Lall et al. (2006) and Hausmann et al. (2007)
Entropy and HH, Overall	Concentration of overall exports by industry. Progressively higher values of the index indicate decreasing concentration.	Computed by author from COMTRADE
Entropy and HH, Industry	Concentration of exports at the SITC 4-digit level within each industry. Concentration of overall exports by industry. Progressively higher values of the index indicate decreasing concentration.	Computed by author from COMTRADE
Entropy and HH, Markets	Concentration of total exports from each country across all their destination markets. Concentration of overall exports by industry. Progressively higher values of the index indicate decreasing concentration.	Computed by author from COMTRADE

Zipf	Coefficient obtained by regressing log (base 10) of share of top 30 exports on the log (base 10) of their rank. A coefficient of -1 marks perfect compliance with Zipf's Law which states that the second ranked product is worth half the first ranked product, the third ranked product is worth one-third the first-ranked product, and so on. Coefficients range from approx. -0.5 to -2, with the smaller values indicating great dominance of a few exports in the country's overall exports.	Computed by author from COMTRADE
Euclidean distance from comparative advantage	Logged values of the revealed human and physical capital indices are subtracted from the national endowment to compute differences which are then squared and standardized to have mean zero and standard deviation of one. The two values for human and physical capital differences adjusted this way are then summed and square-rooted.	Computed by author from UNCTAD data set on RFI and endowments
Parts and components	Parts are a subset of product categories that are not finished or final. Just over 500 of the nearly 4000 manufactured products have been defined as parts/component. Industries at the SITC 2-digit level where trade in parts and components exceeds 50 percent of total indicates their amenability to global production fragmentation. The most conspicuous of these industries are ICT (SITC 75+76+772+776) and power generating machines (SITC 71).	Athukorala and Menon (2010)
Processed food	Processed foods undergo substantial processing in the country of origin before being exporting. They are a subset of a broader SITC category of food, beverages, tobacco, and live animals (SITC Sections 0, 1, 4 and Division 22, net of Division 43 and Group 121).	Athukorala and Sen (1998)
Rauch	Each product at the SITC 4-digit level (Rev. 2) grouped into one of three categories: "homogeneous," "reference-priced" and "differentiated." Homogeneous goods have generally uniform prices and are traded in organized exchanges. Reference prices can be obtained from trade publications without knowing the name of the manufacturer. Differentiated products vary widely in terms of quality and price.	Rauch (1999)
(Log of) Initial Value	The value of each product in US dollars at the HS 6-digit level during the year an export spell begins.	COMTRADE
(Log of) Distance	Distance in kilometers between two countries using the great circle formula which uses latitudes and longitudes of each country's most populated cities or official capital.	CEPII
Contiguity	1 for pairs of countries that share a border; 0 otherwise.	CEPII
Colony	1 for pairs of countries ever in a colonial relationship; 0 otherwise.	CEPII

Language	1 if a language is spoken by at least 9 percent of the population in both countries; 0 otherwise.	CEPII
(Log of) Real GDP	Gross domestic product (constant 2000 US$) for each year of observation.	WDI
(Log of) Real GDP per capita	Gross domestic product per person (constant 2000 US$).	WDI
BTA	1 for a bilateral preferential trade agreement in existence between the exporting and importing countries during a year of observation; 0 otherwise.	United States Trade Representative (USTR)
AGOA	1 for all countries in Africa benefiting from trade preferences granted by the African Growth and Opportunity Act (AGOA) in the US; 0 otherwise.	
AGOA-TC	1 for all countries in Africa benefiting from the special apparel provision of the African Growth and Opportunity Act (AGOA) in the US; 0 otherwise. The provision accords lenient time-bound rules-of-origin criteria.	
(Log of) Normalized Real Exchange Rate	Each country's real exchange rate vis-a-vis the US Dollar and the Euro divided by the weighted average of real exchange rates of all other countries also exporting to the US and EU. The ratio when logged approximates the yearly differences as percentage change in the relative real exchange rate. Positive change implies increase in competitiveness relative to the currency of other countries. The base year for calculation of indices is 2005.	Computed by author from CPI and nominal exchange rate data in WDI

Table 3.15: Developing Countries with High Export Growth, 1998-2008

	Country	All Goods (1)	Non-fuel (2)	Manufactured (3)
KHM	Cambodia	18.98	21.09	2.98
CHN	China	17.82	18.7	1.03
THA	Thailand	10.7	11.37	1.84
VNM	Vietnam	18.85	19.88	2.51
ALB	Albania	19.36	18.85	0.15
BLR	Belarus	15.19	12.09	0.28
BIH	Bosnia and Herzegovina	17.37	18.23	0.51
GEO	Georgia	20.01	17.27	0.05
LTU	Lithuania	18.58	17.01	0.26
MKD	Macedonia, FYR	10.31	10.63	0.73
TUR	Turkey	15.14	16.17	0.52
UKR	Ukraine	18.06	16.94	0.78
BRA	Brazil	12.34	13	0.22
CHL	Chile	14.13	15.33	0.14
COL	Colombia	10.45	10.27	0.25
CRI	Costa Rica	10.46	12.59	2.26
NIC	Nicaragua	10.87	12.45	1.42
PER	Peru	15.12	16.43	0.13
EGY	Egypt, Arab Rep.	15.44	17.85	0.44
IRN	Iran, Islamic Rep.	18.05	18.35	0.07
JOR	Jordan	15.33	17.97	1.28
LBN	Lebanon	14.54	16.11	0.46
TUN	Tunisia	10.35	10.33	0.81
BGD	Bangladesh	10.16	11.94	0.9
IND	India	15.2	15.73	0.26
MOZ	Mozambique	21.98	23	0.1
ZAF	South Africa	11.14	12.84	0.78
TGO	Togo	11.48	15.22	2.41

Source: Computed by author from COMTRADE

Note (1): Per capita average annual compound growth rate (%)

Note (2): average annual compound growth rate (%)

Note (3): percentage point change in manufactured exports/GDP

Table 3.16: Sophistication Scores of Selected Products

HS 6-digit	Product	Log of RFI
	HIGH SOPHISTICATION SCORES	
291242	Aldehyde-ethers, aldehyde-phenols	4.5547
30212	Salmon/trout, fresh	4.5415
900120	Optical fibres/plates	4.5050
871150	Motorcycles, etc. > 800cc	4.4846
30263	Other fish, excluding livers	4.4839
30551	Dried fish (cod)	4.4820
291250	Cyclic polymers of aldehydes	4.4812
290721	Polyphenols :– Resorcinol	4.4735
681520	Articles of peat	4.4672
910121	Watches nes prec metal	4.4671
370241	Photo film roll unexposed	4.4653
871140	Motorcycles et 500-800cc	4.4586
370294	Photo film of a width exceeding 16m	4.4560
370255	Other film, for colour photography	4.4533
910221	Other wrist-watches	4.4514
	LOW SOPHISTICATION SCORES	
284410	Natural uranium and its compounds	0.1661
560710	Twine/cordage/rope/cable	1.7570
410612	Tanned goat/kid leather	1.8341
920600	Percussion musical instruments	1.8689
570110	Carpet, knotted, wool/hair	1.9953
460199	Plaits, plaited products	2.0196
531010	Woven jute, etc., fabrics	2.0961
30759	Octopus/squid, frz/dry/sa	2.1746
70820	Legumes, fresh/chilled	2.2079
530710	Jute etc., yarn	2.3162
630510	Jute etc., sacks/bags	2.3331
30371	Herring/sardine/sprat	2.3460
530720	Multiple (folded) or cabled jute	2.3556
621420	Shawl scarf of wool or fine animal hair	2.3671
410620	Prepared goat/kid leather	2.3872

Source: Computed by author from the RFI database prepared by Shirotori et al. (2010)

Table 3.17: Export Survival (Without Frailty, 1998-2008)

	(1) Probit	(2) Logit	(3) Cloglog	(4) Probit	(5) Logit	(6) Cloglog
Entropy Overall	-.201***	-.344***	-.250***			
	(.059)	(.100)	(.070)			
Entropy Industry	.007	.017	.011			
	(.011)	(.018)	(.014)			
Entropy Market	.071	.118	.087			
	(.049)	(.084)	(.060)			
RFI	.211***	.394***	.322***	.209***	.390***	.319***
	(.025)	(.040)	(.029)	(.025)	(.040)	(.029)
Initial Value	-.139***	-.258***	-.211***	-.139***	-.259***	-.212***
	(.004)	(.009)	(.009)	(.004)	(.009)	(.009)
Multiple spell	-.233***	-.434***	-.356***	-.232***	-.432***	-.355***
	(.019)	(.029)	(.020)	(.019)	(.029)	(.020)
Real GDP	-.092***	-.160***	-.123***	-.088***	-.153***	-.118***
	(.012)	(.022)	(.018)	(.012)	(.022)	(.017)
Real GDP Per Capita	.049**	.082**	.061**	.048**	.081**	.060**
	(.019)	(.034)	(.025)	(.020)	(.034)	(.026)
Normalized RER	-.001	-.001	-.000	-.001	-.002	-.000
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)
BTA	-.096**	-.168**	-.133**	-.095**	-.166**	-.132***
	(.042)	(.074)	(.056)	(.039)	(.068)	(.051)
Distance	-.030	-.048	-.036	-.022	-.033	-.024
	(.028)	(.047)	(.033)	(.032)	(.053)	(.036)
Language	.007	.021	.021	.026	.054	.047
	(.038)	(.066)	(.050)	(.038)	(.066)	(.050)
HH Overall				-.484***	-.825***	-.589***
				(.129)	(.217)	(.147)
HH Industry				-.024	-.021	-.020
				(.059)	(.099)	(.070)
HH Market				.156	.246	.181
				(.173)	(.291)	(.199)
No.	423251	423251	423251	423251	423251	423251

Note 1: standard errors in parenthesis

Note 2: statistical significance indicated as * for p<0.1, ** for p<0.05, and *** for p<0.01

Table 3.18: Export Survival (Cox PH Model, 1997-2008)

	(1)	(2)	(3)	(4)
	Entropy	HH	Entropy	HH
	Censored		Uncensored	
Entropy Overall	.867***		.811***	
	(.037)		(.046)	
Entropy Industry	1.012		1.016	
	(.010)		(.012)	
Entropy Market	1.032		1.108**	
	(.040)		(.057)	
RFI	1.173***	1.172***	1.323***	1.319***
	(.022)	(.022)	(.031)	(.031)
Initial Value	.910***	.910***	.812***	.811***
	(.003)	(.003)	(.009)	(.009)
Real GDP	.938***	.939***	.897***	.902***
	(.011)	(.011)	(.013)	(.013)
Real GDP Per Capita	1.030	1.030	1.062***	1.063***
	(.019)	(.019)	(.023)	(.024)
Normalized RER	1.001*	1.001*	1.003***	1.003***
	(.001)	(.001)	(.001)	(.001)
BTA	.879***	.881***	.898**	.896**
	(.031)	(.029)	(.049)	(.044)
Distance	.978	.984	.963	.980
	(.022)	(.024)	(.026)	(.029)
Language	1.039	1.052	1.001	1.028
	(.037)	(.036)	(.039)	(.042)
HH Overall		.705***		.623***
		(.067)		(.071)
HH Industry		1.022		1.029
		(.045)		(.054)
HH Market		1.045		1.208
		(.131)		(.193)
No.	100293	100293	132088	132088

Note 1: standard errors in parenthesis

Note 2: statistical significance indicated as * for $p<0.1$, ** for $p<0.05$, and *** for $p<0.01$

Table 3.19: Export Survival (Robustness Tests I)

	(1) Probit	(2) Logit	(3) Cloglog	(4) Probit	(5) Logit	(6) Cloglog
Zipf Coefficient	-.141***	-.203***	-.107***	-.121***	-.165***	-.081***
	(.022)	(.038)	(.027)	(.022)	(.038)	(.027)
Entropy Industry	-.002	.003	.004	-.007	-.005	-.001
	(.010)	(.017)	(.012)	(.010)	(.017)	(.012)
Entropy Market	-.095***	-.187***	-.125***	-.106***	-.208***	-.141***
	(.015)	(.027)	(.019)	(.016)	(.027)	(.019)
RFI	.145***	.269***	.216***			
	(.009)	(.015)	(.012)			
Initial Value	-.146***	-.270***	-.219***	-.145***	-.268***	-.218***
	(.001)	(.003)	(.002)	(.001)	(.002)	(.002)
Multiple spell	-.223***	-.415***	-.341***	-.218***	-.404***	-.335***
	(.006)	(.010)	(.008)	(.006)	(.010)	(.008)
Real GDP	-.088***	-.156***	-.122***	-.085***	-.152***	-.118***
	(.007)	(.013)	(.009)	(.008)	(.014)	(.010)
Real GDP Per Capita	-.011	-.033*	-.028**	-.015	-.041**	-.035**
	(.010)	(.018)	(.013)	(.011)	(.019)	(.014)
Normalized RER	-.001***	-.002***	-.001***	-.002***	-.002***	-.001***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
BTA	-.042**	-.076***	-.080***	-.044***	-.077***	-.080***
	(.017)	(.029)	(.022)	(.016)	(.028)	(.021)
Distance	.044***	.080***	.046**	.046***	.083***	.045**
	(.015)	(.027)	(.019)	(.017)	(.029)	(.021)
Language	.020	.054	.064**	.014	.045	.056*
	(.022)	(.039)	(.028)	(.024)	(.042)	(.030)
Rauch				-.154***	-.264***	-.191***
				(.006)	(.011)	(.008)
No.	423251	423251	423251	447817	447817	447817

Note 1: standard errors in parenthesis

Note 2: statistical significance indicated as * for p<0.1, ** for p<0.05, and *** for p<0.01

Note 3: models include random effects at the country-industry level

Table 3.20: Export Survival (Robustness Tests II)

	(1) Baseline	(2) Value>10K	(3) Value>100K	(4) Spell>2 yrs.	(5) Gap Adjusted
Entropy Overall	-.211***	-.283***	-.369***	-.261***	-.298***
	(.019)	(.023)	(.035)	(.024)	(.019)
Entropy Industry	.004	-.001	-.013	-.003	-.002
	(.010)	(.012)	(.017)	(.012)	(.010)
Entropy Market	-.056***	.001	**.121***	.008	**.047***
	(.016)	(.019)	(.028)	(.019)	(.016)
RFI	.147***	.132***	.102***	.135***	.154***
	(.009)	(.011)	(.018)	(.011)	(.009)
Initial Value	-.145***	-.157***	-.156***	-.138***	-.125***
	(.001)	(.002)	(.004)	(.002)	(.001)
Multiple spell	-.223***	-.156***	**.070***	**-.011**	-.165***
	(.006)	(.008)	(.015)	(.008)	(.007)
Real GDP	-.095***	-.095***	-.106***	-.078***	-.100***
	(.007)	(.008)	(.011)	(.008)	(.007)
Real GDP Per Capita	.004	.048***	.096***	.049***	.053***
	(.010)	(.012)	(.016)	(.012)	(.010)
Normalized RER	-.001***	-.002***	-.003***	-.003***	-.002***
	(.000)	(.000)	(.000)	(.000)	(.000)
BTA	-.036**	.012	.050	.000	.039**
	(.017)	(.021)	(.036)	(.022)	(.017)
Distance	.045***	.045***	.015	.022	.021
	(.015)	(.017)	(.023)	(.017)	(.015)
Language	.007	-.016	-.052	-.020	-.058***
	(.022)	(.024)	(.033)	(.024)	(.022)
No.	423251	317256	177037	362516	423217

Note 1: standard errors in parenthesis

Note 2: statistical significance indicated as * for p<0.1, ** for p<0.05, and *** for p<0.01

Note 3: models include random effects at the country-industry level

4

COORDINATING TAX REFORMS: CAN LOST TARIFFS BE RECOUPED?

> "Import tariffs should generally be ranked between four and twenty percent ad valorem intended for [the monarch's] revenue rather than for trade limitation."
>
> – Kautilya, *Arthashastra*, circa 300 BC[1]

> "Little else is requisite to carry a state to the highest degree of opulence from the lowest barbarism, but peace, *easy taxes*, and a tolerable administration of justice."
>
> – Adam Smith, quoted in the *Collected Works of Dugald Stewart*, 1755[2]

4.1 INTRODUCTION

This paper analyzes the immediate revenue implications of trade and domestic tax reforms. The emphasis on "immediate" is important because over the long run, a less distorted economy allocates resources better and is likely to contribute to economic growth that widens the tax base. Liberalization thereby pays for itself over time. Even in the short run it is not always the case that tariff cuts automatically lead to revenue losses (Greenaway & Milner 1991).[3] However, if the imme-

1 See Waldauer et al. (1996)

2 See section IV of Stewart (1755), emphasis added.

3 This depends on the price elasticity of imports and exports, as well as the ability of the economy and tax administrations to respond to altered incentives. Lowered tariffs reduce the incentive to smuggle and bring goods through the informal channels. Lower tariffs also stimulate increased imports. The nature of trade liberalization also matters: while a gradually reforming country with a moderate

diate cost of potential revenue loss is not addressed, trade reforms are not only unlikely to be undertaken, but they can be promptly reversed: Buffie (2001) cites at least 12 episodes where revenue shortfalls triggered partial or full policy reversals in recent decades.[4]

The conventional wisdom imparted in tax policy advice to developing countries over the past 30 years has been that domestic consumption or income taxes are superior to trade taxes because the former can meet the government's revenue target with lower rates, a wider base, and without a protectionist bias. This is underpinned by economic theory. Trade taxes introduce a wedge between foreign and national prices which distort the allocation of resources by encouraging activities in sectors that are viable only at prices above the world average. Dixit (1985) shows that small, open economies are better off reducing tariffs to zero and depending instead on destination-based consumption taxes.

As countries build capacities to extract tax revenue from income and domestic consumption, the importance of trade taxes as a source of government finance tends to decline.[5] Figure 4.1 depicts this starkly with trade taxes being a substantial portion of total tax revenues relative to GDP in low-income countries, but negligible in high-income countries. In the 1950s, developing countries that are today classified as middle-income such as Colombia, Indonesia, Malaysia, Nigeria, Sri Lanka and Thailand derived more than 40 percent of government revenue from trade taxes (Lewis 1963; Corden 1997). By 1989, import duties as a share of total *tax* revenue in developing countries were nearly 25 percent, on average, but in developed

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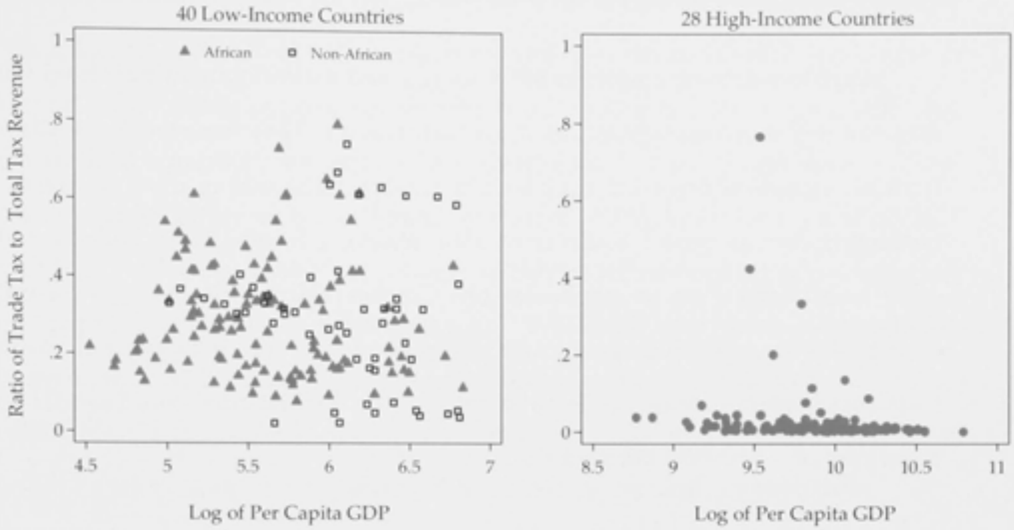
range of tariffs may lose revenue when it cuts them below a certain threshold, others that are still in the process of converting quotas into tariffs could have a revenue windfall.

4 Philippines (1991), Kenya (1983), Morocco (1987), Guinea (1990, 1992), Bangladesh (late 1980s), Malawi (1980s), Senegal (after 1989), Costa Rica (1995), Mexico (1995), Brazil (1995), Colombia (1996).

5 Corden (1997) offers reasons why trade taxes become a less important source of government revenue as countries become rich: i) collection costs of non-trade tax like income fall; ii) the capacity of manufactured import-competing industries improve reducing the need for tariffs for either protection or revenue; iii) as imports evolve from being associated with luxury to becoming part of the general population's consumption basket, the progressive tax function played by tariffs diminishes; and iv) the pattern of imports shifts away from final consumer goods to intermediate and capital goods, because tariffs on intermediate goods lower effective protection for final goods, and are therefore likely to be reduced.

Figure 4.1: Contribution of Trade Taxes to Total Tax Revenue



Source: Baunsgaard and Keen (2010)
Note 1: Each dot is a five-yearly average between 1982 and 2006
Note 2: The only high income country in the sample with the ratio of trade tax to total tax revenue exceeding 0.2 is Kuwait

countries only 2.7 percent (Burgess & Stern 1993). In 2009, customs and other import duties still accounted for more than 10 percent of tax revenue in at least 24 countries. A majority of countries that rely excessively on trade taxes belong to the group of 48 poor nations classified by the United Nations as Least Developed Countries (LDC).[6]

However, if countries embark on a path of rapid trade liberalization without finding adequate sources of alternative domestic revenue, they can face hard fiscal constraints. Table 4.16 lists 40 low-income countries (studied in the next section) and compares the collection of both total and trade taxes relative to GDP across two decades. Of the 22 low-income countries that collected a lower tax revenue as a share of GDP in 2002-06 than in 1982-86, 21 (except Nigeria) also had a lower trade tax as a share of GDP in the most recent period.[7] Only 12 relied less on trade tax

6 See United Nations (2011). This group includes 33 countries from Sub-Saharan Africa, 14 from the Asia-Pacific and one from the Caribbean. Fifteen of them are landlocked and nine are small island states.

7 For five countries indicated in Table 4.16, the most recent period is 1997-2001.

while increasing their overall tax revenue collection. The remaining six increased both their trade tax and total tax collection.

Many low-income countries have not reached a development threshold where they can rely more on sophisticated tax instruments. They have weak tax administrations, as well as large informal sectors (with unrecorded or illicit transactions), narrowing the tax base.[8] Trade taxes also involve a lower cost of collection than other taxes. Such costs, as emphasized by Corden (1997), include i) administrative costs of the tax-collecting agency and ii) resource costs and distortions incurred by taxpayers to minimize or evade payments, which if substantial could render trade taxes part of a *first*-best tax package.

In this paper, I combine trade theory, cross-country evidence, and an in-depth case study of a low-income country, Nepal, using a unique data set on all import transactions at the border.[9] I find that low-income countries have had a mixed record of achievement in offsetting reductions in trade tax revenue. This is partly because of their weak enforcement of domestic taxes like VAT. In principle, a strict enforcement of a positive, single-rated VAT with no exemptions is a highly effective form of modern taxation, and can negate substantial losses in tariff revenue. I confirm this by using a partial equilibrium model to simulate reforms using data from Nepal on tariffs and up to *ten* additional domestic taxes imposed on more than 400,000 import transactions between January 1 and December 31, 2008.[10]

The paper proceeds as follows. Section 4.2 uses panel data from selected low-income countries to assess whether they have succeeded in replacing trade taxes with domestic sources over a period of 25 years. Given the limitations for country-specific policy inference from cross-country regressions, section 4.3 covers a coun-

8 Buehn & Schneider (2007) estimated the size of the informal sector to be 35.5 percent of official GDP, on average, in 76 developing countries, 36.7 percent in 19 transition countries, and 15.5 percent in 25 OECD countries in 2004-05. The burden of taxation is one of the factors that drives activities to become unofficial and unreported.

9 "Border" in this paper refers to a generic port of entry. In many countries, a substantial share of imports arrives by air into cities that may not technically be on the border.

10 In 2009-10, 22.5 percent of the government's tax revenue was generated from tariffs on imports (Government of Nepal 2011).

try case study. It begins by adapting conditions for welfare-enhancing tariff cuts to a revenue-enhancing result from a *coordinated* tariff and tax reform in the presence of an informal sector. Two sets of plausible policy reforms are then simulated: i) different tariff cutting approaches are matched by domestic tax reforms with and without the assumption of a large informal sector; and ii) tariffs and other discriminatory charges on imports from members party to the Agreement on the South Asian Free Trade Area (SAFTA) are eliminated with and without Sensitive Lists that exempt a subset of products from tariff cuts.[11] I check for robustness of results with different parameter assumptions of elasticities for product substitution among exporters, between exporters and domestic producers, and overall demand. Section 4.4 highlights two additional aspects of tariff reform. Section 4.5 concludes.

4.2 CROSS-COUNTRY EVIDENCE ON REVENUE RECOVERY

To set the stage for a detailed country case study, I examine in this section the cross-national evidence from a sample of 40 low-income countries on their record of replacing trade taxes with domestic sources over time. As trade taxes as a share of GDP have altered, how have poor countries fared in terms of domestic tax collection? In other words, for every dollar "lost" in trade taxes, how many cents have they recouped through domestic sources? A cross-national estimation of this nature requires a dynamic panel regression involving detailed tax data that are not always publicly available. I, therefore, use internally compiled IMF data and the estimation strategy of Baunsgaard & Keen (2010). I make three major changes to their data and specification (explained later) to derive results for revenue recovery by low-income countries that are comparable to, if not stronger than the estimations in Baunsgaard and Keen (2005, 2010).

11 Note that tariff cuts often take place as part of a broader package of trade policy reforms. Liberalization of trade policy implies more than tariff cuts, for example, the conversion of quotas into tariffs, elimination of tariff exemptions and trade-related subsidies, reform of state-trading monopolies, raising of low tariffs, elimination of export taxes, removal of foreign exchange rationing and import licensing regimes, among others. Often these are coupled with macro-economic reforms to influence exchange rates, inflation, and incentives for investment.

4.2.1 *Econometric Model*

The basic econometric specification is as in equation 4.1. The dependent variable is total domestic tax revenue (net of trade taxes) as a share of GDP (DT_{it}). Subscripts i and t indicate country and time, respectively. The main explanatory variable of interest is trade tax revenue relative to GDP (TT_{it}). If its coefficient β_1 is significantly negative, it can be concluded that a fall in trade taxes has been associated with a rise in non-trade tax revenue. In the long term, the relevant coefficient is $\frac{-\beta_1}{(1-\beta_o)}$. Time and country-fixed effects are captured by μ_t and α_i.

$$DT_{it} = \alpha_i + \beta_o DT_{it-1} + \beta_1 TT_{it} + \beta_2' \mathbf{X}_{it} + \mu_t + \epsilon_{it} \tag{4.1}$$

The control variables ($\mathbf{X}_{it}$) are those that affect either the costliness of raising revenue from non-trade sources or the valuation of public expenditure. If the marginal value of public expenditures foregone with lost trade taxes is high, the urgency to seek alternative sources is greater. The control variabes are:

- GDP per capita: demand for government expenditures increases as average incomes of citizens grow (Wagner's Law). GDP per capita also proxies for administrative and institutional capacity in the country to collect and manage taxes. (Institutional capacity is proxied better by measures of the quality of governance like the WGI, but their cross-national time-series does not go as far back as the 1980s.)

- Imports: it is the share of total imports relative to GDP. It captures "openness" of the economy as well as the fact that imports are a substantial part of the domestic tax base in poor countries. Baunsgaard & Keen (2010) use for openness a slightly broader measure: the share of exports and imports in GDP, citing Rodrik (1998) who finds this measure of openness to be closely associated with the size of government.

- Natural resources per capita: two measures are introduced as important controls to capture the fact that states that derive a large share of revenues from natural resources do not need to tax their citizens highly (Ross 2001).
- Foreign aid as a share of national income: this could have a perverse effect on the urgency of finding an alternative source of domestic revenue.
- Share of agriculture in GDP: this measures the size of the economy that is hard to tax, as well as the degree of informality prevailing in the economy.
- Inflation: reflects the extent to which revenue is generated from seigniorage, which needs to be controlled for.
- VAT: a modern VAT regime that is strictly enforced is associated with increased domestic revenue collection; however, a weakly enforced VAT system with widespread exemptions could be revenue-reducing compared to taxes collected at fixed border points.

4.2.2 *Data*

The IMF's Government Finance Statistics is the best publicly accessible source for cross-country data on tax revenue, but it is incomplete and suffers from mismeasurement. I therefore use the same panel data as that used by Baunsgaard & Keen (2010) who adjust the GFS data by cross-checking numbers with internal IMF figures obtained through ("Article IV") consultations with individual countries. They try to correct a common flaw in many countries where tariff and VAT revenues are conflated if they are both collected at the border. This would be problematic for the exercise in this paper because the aim is to find out whether decline in tariff revenues are made up for by domestic sources like VAT and excise.

I make three modifications to Baunsgaard and Keen's data set. First, their data on VAT is only a binary variable of whether the country had VAT in place in the year concerned. I use in its place actual ad valorem rates, compiled from three different sources as follows: Krever (2008), Ernst & Young (2008) and World Bank 2011*a*. Second, I confine my analysis to 40 low-income countries over a shorter time period of 25 years, from 1982 to 2006.[12] Third, I use two new measures for a country's abundance in natural resources as an additional explanatory variable. The first measure is the per capita natural resource-based exports (belonging to SITC Section 3 and Division 27, 28 and 68).[13] Exports, however, could be misleading as a measure of natural resource abundance because a country that is too poor to consume its own natural resources exports much of its output, compared with a richer country which exports less but produces just as much. Therefore, I also use a second measure – oil and gas rents per capita – taken from the World Bank's Adjusted Net Savings data center.[14]

4.2.3 *Estimation Method*

I use four different estimation methods. The first method uses the fixed effects "within" estimator in equation 4.1 where the dependent variable – domestic taxes (net of trade taxes) – is regressed on a set of explanatory variables explained earlier. The fixed effects model removes the correlation between time-invariant unobserved effects and the explanatory variables. The main explanatory variable – tax revenue as a share of GDP – is, however, possibly endogenous. Both the collection of non-trade tax and trade tax revenues could, for example, be driven by a reformed customs administration.

The second method, therefore, addresses the potential endogeneity of trade tax by using instrumental variables which are its own first and second lags. De-

12 Five countries drop out of the regression because of incomplete data on inflation and per capita income, as follows: Comoros, Guinea, Myanmar, Sao Tome and Principe, and the Solomon Islands.

13 These are primarily fuel, metals, and ores, whose total export values for the years 1982-2006 I obtained from partner country records in COMTRADE. Because the values are inclusive of cost, insurance, and freight (c.i.f.), I use an ad hoc coversion factor of 1.1 to bring them closer to their f.o.b. values.

14 See Bolt et al. (2002).

spite these corrections, a bigger problem in the first two models as specified in equation 4.1 is that the presence of the lagged dependent variable as one of the explanatory variables regressor (DT_{it-1}) renders the estimates inconsistent because of its correlation with the fixed effect, causing a dynamic panel bias (Nickell 1981). There could also be serial correlation in the error term. Roodman (2009) offers a useful guide on the use of dynamic panel estimators in these situations.[15]

In the third method, I use the Generalized Method of Moments (GMM) estimation method of Arellano & Bond (1991). Equation 4.1 is first-differenced as in equation 4.2 to control for unobserved effects; lagged dependent and explanatory variables are used as instruments.

$$\triangle DT_{it} = \beta_0 \triangle DT_{it-1} + \beta_1 \triangle TT_{it} + \beta_2' \triangle \mathbf{X}_{it} + \triangle \mu_t + \triangle \epsilon_{it} \qquad (4.2)$$

The regression equation in differences (equation 4.2), however, is not satisfactory when the explanatory variables are persistent over time. In such situations, lagged levels of these variables are poor instruments, leading to biased coefficients (finite sample bias). An improved option is to use the linear GMM estimator of Arellano & Bover (1995) which combines the regression equation in differences and the regression equation in levels into one system (System GMM). In this method, bias is reduced by including more informative moment conditions. As explained by Blundell & Bond (2000), the equation in levels uses lagged first differences as instruments and the equation in first differences uses lagged levels as instruments. Next, I report results obtained from all four estimation methods.

15 Roodman (2009) states that dynamic panel estimators are suitable in the following situations: (i) panels that have a relatively small number of years but large number of countries; (ii) the dependent variable is affected by its own past realization; (iii) some explanatory variables are not strictly exogenous; (iv) there are fixed (country) effects; and (v) there is heteroskedasticity and autocorrelation within countries. My data and model satisfy all these criteria, thus justifying the use of GMM estimators. This approach is also taken by Baunsgaard & Keen (2010).

4.2.4 *Results*

Column 1 of Table 4.1 reports the fixed effects estimates of the model.[16] The coefficient of trade taxes is not statistically significant, suggesting that the sample of 35 low-income countries included in the regression was not able to recoup lost trade tariffs with increase in domestic taxes. The coefficient on long term replacement (ω) is also not significant.[17]

Column 2 reports Instrumental Variables (IV) estimates from the Two-Stage Least Squares (2SLS) model on equation 4.1. The coefficient on trade tax is negative and statistically significant at the 5 percent level. Although both trade tax and domestic tax variables are expressed relative to GDP, for a clearer insight into the magnitude of this coefficient, it could be said that for every dollar lost on trade taxes, low-income countries have recouped nearly 25 cents in the short run. In the long run, as indicated by ω, the recovery rate per dollar is nearly 74 cents.

The estimates in column 3 (Difference GMM) show that there is a large recovery of trade tax in the short run (nearly 79 cents for each dollar lost) but not in the long term. This coefficient is significant at the 10 percent level, but it is likely to be biased. This is generally detected if the size of the coefficient of the lagged dependent variable obtained under a first-differenced GMM is smaller that obtained under the fixed effects model.

In column 4 (System GMM), the coefficient on short-term recovery is statistically significant at the 1 percent level, suggesting that low-income countries recouped nearly 46 cents in the dollar.[18] Furthermore, the coefficient on the lagged dependent variable in System GMM lies between those obtained under fixed effects

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16 Hausman specification test rejects the assumption of random effects.

17 This is $\frac{-\beta_1}{1-\beta_0}$. The statistical significance of such a combination of coefficients is calculated by the "delta method" in Stata.

18 The coefficient for long-term replacement is very high, at 2.18, but it is only significant at the 25 percent level.

Table 4.1: Tax Recovery in Low-Income Countries, 1982-2006

	(1) FE	(2) IV	(3) Diff. GMM	(4) System GMM	(5) System GMM
Lagged Total Tax Revenue	.694***	.665***	.658***	.830***	.758***
	(.034)	(.041)	(.115)	(.128)	(.082)
Trade Tax Revenue	-.045	-.249**	-.789*	-.457***	-.320**
	(.069)	(.103)	(.442)	(.155)	(.126)
Share of Imports in GDP	.036**	.044***	.078***	.066*	.066***
	(.014)	(.016)	(.030)	(.037)	(.019)
Natural Resources Exports Per Capita	-.070	-.067	-.061	.023	
	(.080)	(.073)	(.108)	(.504)	
Oil and Gas Rent Per Capita					.010
					(.083)
Share of Agriculture in GDP	-.041*	-.046**	-.120***	-.044	-.049*
	(.023)	(.020)	(.040)	(.511)	(.026)
Share of Aid in GDP	-.010	-.003	-.001	-.027	-.020
	(.009)	(.010)	(.022)	(.132)	(.014)
Log of Inflation	.017	.046	-.165	.035	.080
	(.125)	(.114)	(.160)	(.733)	(.117)
Log of Per Capita GDP	-.371	-.071	1.705	-.822	-.545
	(.630)	(.609)	(2.699)	(15.637)	(.771)
VAT	.026*	.027**	.051***	.027	.006
	(.013)	(.013)	(.019)	(.135)	(.019)
Long term replacement (ω)	0.148	0.74***	2.31	2.69	1.32***
	(0.225)	(0.241)	(1.43)	(2.62)	(0.638)
Serial correlation (1st order)			-3.24***	-3.05***	-3.22***
Serial correlation (2nd order)			0.44	0.77	0.61
No. of observations	645	643	567	645	672
Adj. R-sq.	.87	.86			
Time dummies	Yes	Yes	Yes	Yes	Yes
No. of countries	35	35	35	35	35
No. of instruments	35	35	35	38	38

Note 1: robust standard errors in parenthesis

Note 2: statistical significance indicated as * for $p<0.1$, ** for $p<0.05$, and *** for $p<0.01$

Note 3: coefficient of the lagged dependent variable in an OLS model (not shown) is 0.89

(0.69) and OLS estimations (not reported, but the coefficient is 0.89).[19] The tests of autocorrelation show that first order serial correlation is present but the second order serial correlation is not, as expected. These checks for the appropriateness of the model specification are in line with what Baunsgaard & Keen (2010) show.

Finally, column 5 reports System GMM estimates with oil and gas rent per capita as a control for natural resource wealth instead of the export per capita of oil, gas, ores, and metals that was used in column 4. The coefficient of short-term recovery of 32 cents to the dollar is statistically significant at the 5 percent level. In this regression, the coefficient of the long-term recovery (US$1.32 for every dollar) is also highly significant.

In sum, the System GMM estimates of tax recovery – between 32 and 46 cents to the dollar in the short run, and 132 cents to the dollar in the long run – are higher than those found in two previous studies with different specifications and years under consideration. Baunsgaard & Keen (2010) found a recovery rate of between 20 and 25 cents for low-income countries, and Baunsgaard & Keen (2005) found for only one of the models a recovery estimate of about 30 cents for each dollar lost.

The IV and the Difference GMM models also find the VAT coefficient to be statistically significant, that is, it was associated with fast positive tax recovery. The VAT coefficient, however, is not significant in the System GMM regressions. That the significance of coefficients of all VAT dummies is not consistently stronger leads to the inference that not all VAT regimes are alike. An attempt to assess the role of VAT regimes in revenue recovery by just looking at the applied ad valorem rate is perhaps incomplete. Their efficacy depends crucially on how they have been introduced along the following dimensions: i) the number and level of the rates; ii) share of products that are exempted; iii) income threshold above which the tax

19 This is reassuring because the OLS estimates are biased upwards and the fixed effects estimates are biased downwards.

applies; iv) coverage of the retail sector and services; and v) effectiveness of the refund system (Keen & Lockwood 2010).[20]

Among other variables, total imports relative to GDP (a proxy for openness) are consistently associated with high rates of domestic tax collection. This is not surprising because imports are a significant part of the VAT base in low-income economies. Contrary to expectations, coefficients of variables measuring natural resource abundance are not significant in any of the estimations. Coefficients of inflation and overseas aid are not statistically significant, whereas those on per capita income and the share of agriculture have the expected signs in selected regressions.

There are caveats to this analysis. In addition to the methodological complexity in asserting a precise relationship between lost trade taxes and domestic taxes, all indirect effects through which control variables like GDP or openness may generate tax revenue over the long run are not analyzed. Indeed, this section of the paper should not be seen as a definitive analysis of the impact of trade liberalization on revenue, but rather as shedding light on what has happened to the share of domestic taxes in GDP across an imperfect sample of poor countries when – for whatever reason – import duties change relative to GDP.

Furthermore, to accurately assess and forecast the likely impact of reforms, there is greater need for nuanced country-specific case studies. The case for the use of in-depth country-specific case studies to understand policy regimes is best articulated by Bhagwati & Srinivasan (1999). They find several problems with cross-country regressions as a method of policy evaluation. Even if the theoretical, data and methodological weaknesses inherent in most cross-country regressions were ignored, the cross-country results, after all, only indicate *average* effects. In view of these shortcomings, I focus next on a detailed country case, of Nepal, where tariffs

20 As confirmed by policy simulations in subsequent sections of this paper, however, a basic rule of thumb is that a broad-based VAT that has a uniform rate and little or no exemptions raise more revenue. Exemptions generally have no investment-promotion effect, and merely offer conducive fiscal loopholes for tax evasion and avoidance (Tanzi et al. 2008).

still constitute more than one-fifth of total tax revenue, and the vast majority of its 30 million people are employed in the largely untaxed agricultural and informal sectors.

4.3 JOINT TRADE-FISCAL REFORM: A CASE STUDY

My contribution in this section is to simulate the revenue consequences of coordinated tax reforms with actual data on import, tariffs, excise duty, value-added tax and para-tariffs from Nepal. I also assess how these reforms change the price and production of domestic manufactures. Because it is often the perceived loss of immediate revenue that leads stakeholders to resist trade reforms in poor countries, the focus is on short-term impacts.

The academic literature on coordinated trade and fiscal reforms in Nepal is scant. Khanal (2006) finds econometrically that trade reform in Nepal over the period 1990-2005 did not lower trade tax revenue. Cockburn (2006) uses a Computable General Equilibrium (CGE) model to study the poverty impact of tariff elimination. His innovation is to incorporate household data in the model to capture complex income and consumption effects. When tariffs are eliminated but compensated by a uniform 1.1 percent increase in consumption tax, he shows that urban poverty falls and rural poverty increases because initial tariffs protected agriculture.

The remainder of the case study is structured as follows. Subsection 4.3.1 derives a theoretical condition required for revenue to improve following a coordinated tariff and tax reform in the presence of an informal sector. The subsections that follow simulate policy reform scenarios with and without a large informal sector, and with and without a Sensitive List.

4.3.1 *Theoretical Motivation*

In an economy with multiple distortions, reduction of one or a subset of distortions (such as tariffs) may not lead to Pareto welfare gains. This is the essence of the theory of second-best launched by Meade (1955) and Lipsey & Lancaster (1956). Welfare may also not be increasing in the number of reforms that are undertaken because of second-best interactions, except when *all* distortions are simultaneously reduced. However, it is impossible to know all distortions and their cross-effects. The challenge in trade policy reform, therefore, is to "design small, feasible changes in the existing tariff structure that will result in a welfare improvement when the first-best policy of free trade is not feasible" (Turunen-Red and Woodland 1993, p. 145).[21]

A more realistic objective of governments is to maximize revenue which can be used in ways to improve national welfare. When the condition that revenue should not fall when undertaking tariff reform is imposed, the welfare-enhancing result of a simple tariff cut is weakened (Falvey 1994). The policy challenge, then, is to undertake tariff reforms in ways that do not reduce welfare *and* revenue. Keen & Ligthart (1999) suggest that any trade tax (tariff) cut that is offset point-for-point by an increase in consumption (domestic) tax that leaves consumer prices unchanged can achieve this goal to some extent.

This evolving consensus on the desirability of revenue-neutral reforms that involve replacing tariffs with value-added tax in developing countries is contested by Emran & Stiglitz (2005). They show that in the presence of an informal sector where economic activities normally go untaxed, such coordinated reforms can prove to be welfare reducing. They find that the threshold of the VAT base of a commodity below which welfare falls is low if the good whose tariff has been cut

21 An example of such a feasible change is to remove the biggest distortions first ("Concertina" tariff reform rule). As shown by Bertrand & Vanek (1971), Hatta (1977) and Lloyd (1974), if the highest tariff is reduced to the next highest level, welfare can improve if the good whose tariff is being cut is a gross substitute of all other goods. The other well-known rule is the "proportionality rule" which shows that if all tariffs are reduced proportionally, welfare can be increased.

belongs to the informal sector. In other words, a reduction in tariff of good k reduces its consumer price and leads to expanded demand for good k. However, if the good is not produced in the formal sector, the government does not receive increased VAT receipts from the sale of good k.[22]

The focus of Emran & Stiglitz (2005) is on the conditions required for *welfare* to increase in the presence of an informal sector. In what follows, I extend their framework to identify conditions for *revenue* to increase in the presence of an informal sector, following a coordinated tax and tariff reform that keeps welfare intact.

Assume a small open economy with a representative consumer that imports products at world price (p^w) before imposing tariffs. There are no externalities. All $(n+1)$ goods are produced using a convex, constant-returns-to-scale technology. There is an informal sector (s) which does not pay consumption tax (ν), so price in this sector is q^s. In the formal sector, domestic price (q^f) is inclusive of both the tariff (t) and the consumption tax (ν). There are four subsets of commodities, importables and exportables, produced in the formal (f) and informal sectors as follows. Informal exportables that face no tariff or tax are the numeraire.

$$\begin{cases} \mathbf{q^f} = \mathbf{p^w} + \mathbf{t^f} + \mathbf{v} : \text{consumer price in the formal sector} \\ \mathbf{q^s} = \mathbf{p^w} + \mathbf{t^s} : \text{consumer price in the informal sector} \\ \mathbf{p^f} = \mathbf{p^w} + \mathbf{t^f} : \text{producer price in the formal sector} \\ \mathbf{p_0} = \mathbf{q_0} = \mathbf{1} : \text{numeraire} \end{cases}$$

The representative consumer is unsatiated, owns all the factors, and maximizes a quasi-concave utility function. The expenditure function minimizes her consumption expense to attain a given utility (u) facing a price vector (q_0, q).

22 The Diamond-Mirrlees theorem states that from the point of view of production efficiency, a small country should not discriminate between domestic and international supply of identical goods. Munk 2008 argues that when tax collection is administratively costly, this theorem fails to hold.

The function is twice differentiable, non-decreasing and concave in q, and homogeneous of degree one.

$$E(q_0, q, u) = \min_{\{c\}} \{p.c \text{ such that } u(c) \geqslant u_0\} \tag{4.1}$$

Production is represented by a GNP function, $G(p_o, p, y)$, which maximizes the value of output facing a price vector (p_0, p). The function is twice differentiable, non-decreasing and convex in p, and homogeneous of degree one in p. It is non-decreasing and concave in y.

$$G(p_0, p, y) = \max_{\{x\}} \{p.x \text{ such that } x(y) \text{ is feasible}\} \tag{4.2}$$

By Shephard's Lemma, E_q is the consumption vector.

By Hotelling's Lemma, G_p is the net output vector.

The net import vector, m, is $E_q(q, u) - G_p(p, y)$.

The government's revenue, R, is raised from tariffs $(t'm)$ and VAT $(\nu' E_{q'})$:

$$R(t, \nu) = t'(E_q - G_p) + \nu' E_{q'} \tag{4.3}$$

Private budget constraint is:

$$E(q_o, q, u) = G(p_o, p, \nu) + R(t, \nu) \tag{4.4}$$

From equation 4.4, when tariff on good k is reduced and VAT on good i is increased:

$$\begin{aligned}
dR &= E_{q_k} dq_k + E_u du + E_{q_i^f} dv_i - G_{p_k} dp_k \\
E_u du &= dR - (E_{q_k} - G_{p_k}) dt_k - E_{q_i^f} dv_i \\
E_u \frac{du}{dt_k} &= \frac{dR}{dt_k} - (E_{q_k} - G_{p_k}) - E_{q_i^f} \frac{dv_i}{dt_k} \qquad (4.5)
\end{aligned}$$

Differentiating equation 4.3:

$$\begin{aligned}
(E_{q_k} - G_{p_k}) dt_k + t'[E_{qq_k} dq_k + E_{qu} du + E_{qq_i^f} dv_i - G_{pp_k} dp_k] & \quad + \\
E_{q^f} dv_i + v'[E_{q^f q_i^f} dv_i + E_{q^f u} du + E_{q^f q_k} dt_k] & \quad = \\
dR & \qquad (4.6) \\
\left[(E_{q_k} - G_{p_k}) + v'E_{q^f q_k} + t'(E_{qq_k} - G_{pp_k})\right] dt_k & \\
+ \left[t'E_{qq_i^f} + v'E_{q^f q_i^f} + E_{q^f}\right] dv_i + \left[t'E_{qu} + v'E_{q^f u}\right] du & \quad = \\
dR & \qquad (4.7)
\end{aligned}$$

Definition 1. Let ψ_i be the marginal effect of a change in v_i on total indirect taxation; and let ψ_k be the marginal revenue effect of a change in t_k. Then $\psi_i = t'E_{qq_i^f} + v'E_{q^f q_i^f} + E_{q_i^f}$ and $\psi_k = (E_{q_k} - G_{p_k}) + v'E_{q^f q_k} + t'(E_{qq_k} - G_{pp_k})$.

Both ψ_i and ψ_k are assumed to be greater than zero.

From equation 4.7 and Definition 1:

$$\frac{dv_i}{dt_k} = -\psi_i^{-1} \left\{ \psi_k + [t'E_{qu} + v'E_{q^f u}] \frac{du}{dt_k} - \frac{dR}{dt_k} \right\} \qquad (4.8)$$

Substituting equation 4.8 in equation 4.5:

$$
\begin{aligned}
-(E_{q_k} - G_{p_k}) - E_{q_i^f}\left[-\psi_i^{-1}\left\{\psi_k + [t'E_{qu} + \nu'E_{q^f u}]\frac{du}{dt_k} - \frac{dR}{dt_k}\right\}\right] &= \\
E_u\frac{du}{dt_k} & \qquad (4.9) \\
\left\{E_u - E_{q_i^f}\psi_i^{-1}\left[t'E_{qu} + \nu'E_{q^f u}\right]\right\}\frac{du}{dt_k} + (E_{q_k} - G_{p_k}) &= \\
E_{q_i^f}\psi_i^{-1}\left[\psi_k - \frac{dR}{dt_k}\right] & \\
-E_{q_i^f}\psi_i^{-1}\frac{dR}{dt_k} + E_{q_i^f}\psi_i^{-1}\psi_k - (E_{q_k} - G_{p_k}) &= \\
Q\frac{du}{dt_k} & \qquad (4.10)
\end{aligned}
$$

In equation 4.10, Q= $\left\{E_u - E_{q_i^f}\psi_i^{-1}\left[t'E_{qu} + \nu'E_{q^f u}\right]\right\}$, and is assumed to be greater than zero for uniqueness and stability (Hatta Normality Condition). Assume further that the tax-tariff reform is welfare neutral (that is, $\frac{du}{dt_k} = 0$). For revenue increase $\frac{dR}{dt_k} < 0$, and $E_{q_i^f}\psi_i^{-1} > 0$. So, from equation 4.10, the condition for welfare-neutral revenue increase is:

$$
\begin{aligned}
(E_{q_k} - G_{p_k}) &< E_{q_i^f}\psi_i^{-1}\psi_k \\
(E_{q_k} - G_{p_k})\frac{\psi_i}{\psi_k} &< E_{q_i^f} \\
(E_{q_k} - G_{p_k})\frac{t'E_{qq_i^f} + \nu'E_{q^f q_i^f} + E_{q_i^f}}{\{(E_{q_k} - G_{p_k}) + \nu'E_{q^f q_k} + t'(E_{qq_k} - G_{pp_k})\}} &< E_{q_i^f} \qquad (4.11)
\end{aligned}
$$

Assume that the cross-price effects are zero, that is, $E_{q_i q_j} = 0$. And let $\delta_k = (E_{q_k} - G_{p_k}) > 0$ as k is an importable. Then equation 4.11 simplifies to:

$$
\delta_k\left\{\frac{(\nu_i + t_i^f)E_{q_i^f q_i^f}}{\nu_k E_{q_k q_k} + t_k(E_{q_k q_k} - G_{p_k p_k})}\right\} < E_{q_i^f} \qquad (4.12)
$$

For revenue to increase in response to a welfare-neutral fall in tariff of good k and an increase in VAT of good i, equation (4.12) requires the latter's VAT base to exceed a certain threshold. The threshold is higher if good k is in the informal sector because when $\nu_k = 0$ the denominator becomes smaller. Note that the reduction in t_k decreases the consumption price q_k and increases the domestic consumption of good k, raising revenue through the VAT, ν_k. However, when the good is in the informal sector, there is no increase in revenue from increased consumption. If the VAT base of formal goods is small (that is, the informal sector is large), revenue following a coordinated tariff and tax reform could decrease. This theoretical postulate guides the analysis of the revenue implications of tax policy reform in Nepal, a country with a large informal sector that is hard-to-tax.[23]

4.3.2 *Model*

The empirical analysis in this section draws on simulations conducted using the Tariff Reform Impact Simulation Tool (TRIST) developed by the World Bank (Brenton et al. 2011). It uses a partial equilibrium model that quantifies the effect of trade reform scenarios on imports, revenue and production (please refer to the appendix for the simulation model and an illustration). The model makes the following key assumptions: (1) it is derived from standard consumer theory and elasticities play a central role in determining the magnitude of demand response to price change; (2) there is imperfect substitution between imports from different countries, following Armington (1969), and each product is modeled as a separate market; (3) the economy is small and open such that all changes in tariffs are passed on, but change in demand by consumers in the small country does not affect world prices.

Percentage change in the price of good j from country i (Δp_{ij}) when tariff and other domestic taxes are lowered is as follows: the prime indicates post-reform values of tariff (τ), excise duty (e) and the VAT (ν).

---

23 Keen (2007) argues that the theoretical result of Emran & Stiglitz (2005) does not fully take into account the efficacy of VAT as a taxation device. It is not just a tax on final consumption, but a charge on all imports and sales at every stage of transaction (with credit or refund given to registered taxpayers of VAT). Thus, while the informal sector can evade income tax, it can only escape from VAT partially, for it acts like a tax on all purchases the informal sector makes from the formal sector. This point is valid, but does not alter the basic thesis that, all else being equal, domestic tax collection is decreasing in the size of the informal sector.

$$\Delta p_{ij} \;=\; \left[\frac{(1+\tau_{ij}^{'})(1+e_{ij}^{'})(1+\nu_{ij}^{'})-(1+\tau_{ij})(1+e_{ij})(1+\nu_{ij})}{(1+\tau_{ij})(1+eij)(1+\nu_{ij})}\right] \tag{4.13}$$

Demand responds to the relative price change in three steps, as explained by Lim & Saborowski (2010). First, shares of expenditure on imports of a product across different exporting countries change when a particular tariff is altered. Total imports remain the same, but if imports of Country A become cheaper, there will be substitution away from imports from other countries. The elasticity of substitution is calculated as follows:

$$\left[\frac{\triangle(M_A/M_B)}{(M_A/M_B)}\right] \;\;/\;\; \left[\frac{\triangle(P_A/P_B)}{(P_A/P_B)}\right] \tag{4.14}$$

where M_A, M_B are the same imports from Countries A and B with prices P_A, P_B, respectively. Second, the allocation of expenditure between imports and domestically produced goods is calculated. Relative demand changes are derived from changes in the weighted average of the price of imports, adjusted by the elasticity of substitution between domestic and foreign products. If the average price of imports falls, there will be substitution away from domestically produced goods, but total consumption stays the same. Third, when average domestic price changes, there will be an overall demand response. Consumers demand more of the good whose price has fallen irrespective of whether it is imported or procured locally.

The partial equilibrium model of importing in TRIST permits a comparison of different policy scenarios with and without the base values changed. Simulations are easy to run by policymakers. However, this simplicity has a trade-off. Because demand for each product is treated in isolation, the partial equilibrium model has no economy-wide intra- or inter-sectoral linkages. It is silent on resource constraints and reallocations that inevitably result from all meaningful trade policy reforms (Brenton et al. 2011). The model, therefore, does not allow us to judge whether policy changes are beneficial from an economy-wide perspective over the long run.

The utility of TRIST is confined to analyzing the impact of tariff and tax changes on *revenue* in the *short-term*. Its results are more useful, for example, in forming trade negotiating positions than, say, crafting medium-term national development strategies.[24] In other words, the partial equilibrium model is not as useful in projecting a medium-term growth rate of the economy than it is in identifying the magnitude of immediate trade adjustment costs in sectors having to face import competition.

4.3.3 *Data*

The empirical analysis uses a new data set extracted from unpublished customs records from Nepal for the calendar year 2008 (Government of Nepal 2009*b*). It contains 417,715 import transactions. In addition to the date when the import shipment was processed, the data set lists the value of each import in Nepali Rupees inclusive of cost, insurance and freight (c.i.f.) and tariffs levied on that import. Customs also raise a substantial share of additional revenue at ports of entry by levying a range of domestic taxes. The main ones in Nepal are the excise duty and VAT, as well as the Agricultural Reform Fee (ARF) imposed on agricultural imports from India only. A range of other charges and taxes (para tariffs) are levied as follows: demurrage, customs service fee, fine, special fee, Road Construction Fee, and the Local Development Tax.[25] The data set lists applied Most Favored Nation (MFN) and preferential tariff rates set for each import at the HS 8-digit level.

24 For a longer run perspective, a CGE model would probably be more suitable. In contrast to the tractability of partial equilibrium models, however, CGE models require a complex data set, a large number of exogenously imposed parameters, and restrictive assumptions rendering the replicability and falsifiability of results difficult. See Taylor & Von Arnim (2007) for a critique of the CGE methodology.

25 As of 2011, the local development tax, road construction fee, and special fee have been phased out.

I check for the consistency of entries and adjust the data set as follows. All import transactions worth Rs. 10,000 (approx. US$140) or less are dropped.[26] Goods entering the country under customs procedure codes which do not compete in the local market are dropped. These are mainly diplomatic and governmental imports that are tax-exempt. Next, I compute the applied tariff rate, applied excise duty, and applied VAT by dividing the actual amount of such taxes collected by their respective base.[27] Those "applied" values that abnormally deviate from the statutory tax rates are dropped. The cleaned data set that is ready for simulation consists of 265,194 import records spanning 4032 tariff lines from 133 economies.[28]

The paper also incorporates domestic production data extracted from the latest quinquennial Census of Manufacturing Establishments that reports the domestic sale of manufactured goods (Government of Nepal 2008). For 3,079 of the 4032 import codes, there exists matching data for domestically sold products. This allows for substitution of imports by domestically produced goods when the price of imports rises, adding to the richness of simulation results. There are, however, two limitations. First, the latest production data are available only up to the fiscal year 2006-07, whereas the import data straddles the fiscal years of 2007-08 and 2008-09 (that is, calendar year 2008). Second, production data covers only manufacturing industries. For a little less than 25 percent of the tariff lines that belong to non-manufacturing industries, there are no data on domestic production. In the language of the model, for a subset of imports, the substitution between imports and domestically produced goods is *perfectly* inelastic.

26 This excludes nearly 30 percent of the observations, which accounts for 3.2 percent of total import value.

27 In Nepal, excise duty is levied as a percentage of import value. VAT is paid as a percentage of the base comprising of import value plus excise and other taxes. The Agricultural Reform Fee (ARF) is levied (in lieu of tariff) on the value of agricultural imports from India. If VAT is additionally levied on such agricultural goods from India, it is a fixed percentage of the import value, *not* import value plus the ARF.

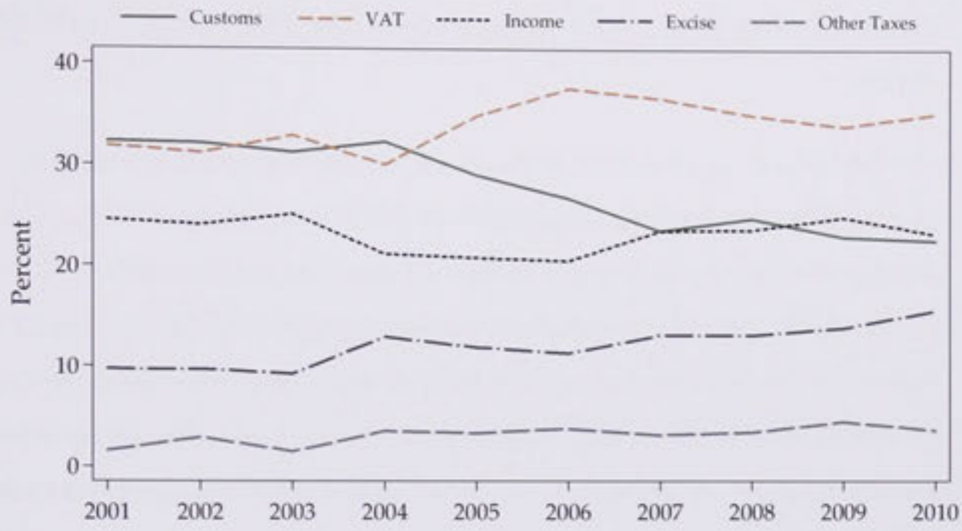
28 The term "economies" is used in lieu of "countries" because Nepal's customs data treat Tibet, Hong Kong, and Taiwan as sources of imports that are distinct from the People's Republic of China even though the three economies are (politically) part of China.

The 133 import trading partners of Nepal in 2008 are organized in eight groups: (1) India; (2) China, including the Tibet Autonomous Region; (3) Rest of South Asia (Afghanistan, Bangladesh, Bhutan, Maldives, Pakistan, Sri Lanka); (4) Northeast Asia (Japan, Republic of Korea, Hong Kong Special Administrative Region, and Taiwan); (5) Southeast Asia (Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam); (6) North America (Canada, Mexico, United States); (7) the European Union; and (8) the Rest of the World (ROW). The baseline scenarios assume an export substitution elasticity of 1.5, domestic substitution elasticity of 1, and import demand elasticity of 0.5.[29]

4.3.3.1 *Import-based Revenue in Nepal*

The structure of tariffs and tariff-based revenue in Nepal is described in this section. Columns 3 to 6 in Table 4.7 show that the collected tariff and VAT rates across all imports are just over 10.5 percent and 11.0 percent, respectively. When imports are weighted by value, those rates drop to 7.0 and 9.9 percent, respectively. That the applied VAT rate of above 11 percent is nearly two percentage points below the statutory rate of 13 percent indicates the scale of average exemptions, a proxy for discretion that the authorities exercise. For tariffs, the scale of average exemptions is the difference between the weighted statutory tariff rate of 8.33 percent and the applied tariff rate of 7 percent.[30] Compared to just 20 years ago, the height of trade protection has fallen considerably, although revenue generated by taxing

Figure 4.2: Share of Tax Revenue by Source



Source: Government of Nepal (2011)
Note 1: Customs includes import tariffs, export duties, Indian Excise Refund

imports through tariffs, VAT and excise continues to be the dominant source of tax revenue in Nepal.

After the adjustments described in the preceding section are made, the total value of imports in 2008 is Rs. 222.19 billion.[31] Table 4.7 shows that in 2008, Nepal received Rs. 15.6 billion in tariff revenue, amounting to 34.3 percent of total revenue derived from imports. VAT on these imports (Rs. 23.9 billion) accounted for 52.7 percent of the total import-based revenue, and the remaining 13 percent was accounted for by excise and other taxes amounting to nearly Rs. 6 billion.

29 I increase the value of these benchmark elasticities subsequently. They are, however, not as high as some of the empirical estimates of elasticity for export substitution and domestic substitution by, for example, Hummels (2001) or Romalis (2007). I opt for smaller elasticities because of the model's focus on short-run outcomes.

30 The extent of exemptions granted can only be assessed for products subject to ad valorem duties. Because the AVE for specific tariffs have been computed by the so-called income method of taking the (median) applied tariff rate, there is no difference between the statutory and collected tariff rates for the category of imports that face specific tariffs.

31 This figure is for the calendar year 2008. Its comparison with total import figures for the fiscal year 2008 deserves care. The reported total import by Nepal in the fiscal year (from July 2008 to July 2009) was Rs. 284.5 billion. In the fiscal year 2007-08 (from July 2007 to July 2008), total import was Rs. 221.9 billion. The raw customs total for the calendar year 2008 is in between the figures for the two fiscal years, at Rs. 236.6 billion. After adjustment, this drops to Rs. 222.2 billion.

Figure 4.2 shows that VAT (on both imports and domestic consumption) surpassed customs-based revenue as the main source of tax revenue after 2004. However, as shown in Table 4.8, at least 62 percent of total VAT revenue is derived from imports.[32]

Table 4.9 shows the distribution of observations by tariff bands ranging from zero to 80 percent for SAFTA and non-SAFTA trading partners. There is an additional row for products (such as fuel, tobacco, alcohol and cement) that face specific tariffs (that is, per quantity, not percentage of value). The first group comprises countries that generally pay a higher rate of applied MFN tariff. The second group of countries pays preferential tariff rate under SAFTA. This group accounts for nearly 64 percent of imports into Nepal, and is almost exclusively dominated by India.

Several features stand out in Table 4.9. First, less than 15 percent of imports (by value) are free of statutory duty. Second, nearly 36 percent of imports are subject to "nuisance" tariffs between zero and five percent; the term indicates that at such low rates the cost of monitoring and collecting tariffs could outweigh the revenue collected. Third, there are 421 observations that are subject to specific tariffs, whose Ad Valorem Equivalent (AVE) is 26 percent. The AVE of specific tariffs is calculated as the median applied tariff rate of all applicable imports at the HS 8-digit level (that is, customs tariff divided by import value). Almost all the goods on which specific tariffs are levied originate in India. These goods account for 19.2 percent of total import value and 22.6 percent of collected tariffs.

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32 Data from the Internal Revenue Department of the Ministry of Finance of the Government of Nepal as published in Government of Nepal (2004), Government of Nepal (2009*a*) and Government of Nepal (2010) show that VAT revenue from imports has exceeded 60 percent over the past 10 years.

4.3.4 *Results*

4.3.4.1 *Coordinated Tariff and Tax Reform with Small Informal Sector*

This section reports results of the impact of five reform scenarios of coordinated tariff cuts and VAT consolidation. In the first scenario, statutory tariffs on all imports are cut by 50 percent, together with a full enforcement of the VAT at the existing 13 percent.[33] Full implementation means that all imports and domestically produced goods are charged a non-discriminatory VAT rate of 13 percent with no exception. All "other" taxes and charges including the Agricultural Reform Fee, fines and demurrage are eliminated.[34]

The essence of this reform is to reduce significantly the distortionary trade tax and recoup potential tariff losses by plugging exemptions on a much wider VAT base. In scenario 1 of Table 4.2, total imports *increase* by 0.3 percent in value. Note that this appears to be a small response to such a drastic cut in tariffs. However, cuts in tariff have been accompanied by an indiscriminate application of the VAT. This could, in some cases, raise the domestic price of the good even though the trade-weighted applied tariff rate drops from 7 to 4.3 percent. This suggests that there is substitution away from domestic production.

The 50 percent cut would not "bite" if some imports were currently being charged less than the statutory tariff rate because of discretion exercised by customs authorities, corruption, or temporary government exemptions. In scenario 1, tariff revenues drop by 38.3 percent, as expected, from Rs. 15.6 billion to Rs. 9.6 billion. The VAT compensates for the tariff loss even when other domestic taxes/charges are eliminated. VAT revenue on imports increases from Rs. 23.9 billion

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33 Note that the statutory tariff rates are applied MFN or preferential rates. They are not bound MFN rates.

34 Nepal has already announced that it would phase out the ARF.

to Rs. 30.6 billion, and VAT revenue on domestically produced goods increases from Rs. 10.7 billion to Rs. 13.6 billion (not shown in a disaggregated manner in the table). Overall, this reform that cuts tariffs by half and enforces the existing VAT ends up being more than revenue-neutral: total revenue goes up by 1 percent, while domestic production suffers a modest loss of 0.14 percent.

In scenario 2, I apply a uniform tariff rate of five percent on all imports from all countries and match that, again, with full implementation of the existing VAT rate of 13 percent and elimination of all other taxes/charges. The tariff cuts are less biting than in scenario 1, because existing tariffs that are already less than 5 percent are increased to five percent. This affects nearly 17 percent of tariff lines, and tariff revenue from this subset increases. However, tariff revenue from products on which the existing tariff rate exceeds five percent is likely to decline. The net effect of this reform on tariff revenue is a loss of 28.9 percent. When the VAT is levied on all imports, the final decline of total tax revenue from imports is from Rs. 45.4 billion to Rs. 44.1 billion. This modest loss is more than made up for by the VAT imposed on domestic products. Overall tax revenue from imports and domestic sales under the second scenario increases by 2.7 percent.

In scenarios 3 and 4, the VAT rate is increased to 15 and 17 percent, respectively. As expected, total revenues increase by 13.3 and 23.7 percent. In scenario 5, I simulate another radical combination of complete full trade with no tariff on any import, matched by a flat VAT of 17 percent on all goods. This leads to a drop in tariff revenue from Rs. 15.6 billion to zero; however, total effect on revenue is a net increase of 4 percent.

The message from the simulation results reported in Table 4.2 is that trade taxes can be reduced without adversely affecting total government revenues by implementing domestic taxes like VAT and excise duties effectively. In fact, if tariffs are used mainly for revenue-raising purposes (that is, not used to protect domestic industries) they could simply be replaced by excise taxes. Like VAT, excise taxes do not discriminate between domestic and international sources. They also do not fall under the purview of trade agreements, so countries under pressure to cut tariffs can simply switch to excise. This would just be a semantic change in nomenclature.

There is, however, a powerful assumption behind the advocacy of a switch in tax regime from tariffs to a broad-based consumption tax, namely, that countries have the capacity to enforce a complicated system like the VAT. One of the main arguments for reliance by poor countries on tariffs has always been that they are easier and less costly to collect at fixed border points.

As postulated in section 2, we need a larger VAT base to raise the same level of revenue in the presence of an informal sector. Piggott & Whalley (2001) show that VAT expansion can reduce welfare if it encourages suppliers to go underground to evade new taxes. The presence of the informal sector, however, may not dent revenue collection to the extent that the theory suggests. This is because a substantial share of revenue in poor countries is generated from VAT on imports which is usually collected at the border together with tariffs. In the Nepali data for 2008, for every rupee collected in tariff revenue, Rs. 1.7 was collected additionally in VAT and excise duty. This point is also made by Keen (2008) that the VAT (and withholding taxes) on imports actually acts as a tax on the informal sector. While the formal sector may claim tax credit on payments made at the border when they eventually pay income and other taxes, the informal sector does not, thereby minimizing loss to the exchequer.

4.3.4.2 *Coordinated Tariff and Tax Reform with Large Informal Sector*

In this subsection, I allow for an exogenous shrinking of the taxable production base (Table 4.3), which is equivalent to the enlargement of the informal sector. In section 2 of this paper, it was shown that the presence of a large informal sector makes it difficult to raise revenue from domestic sources. To proxy for the informal sector, I run the same simulations as in Table 4.2, but with the assumption that the taxable domestic base has shrunk by 30 percent.

In scenario 1 presented in Table 4.3, the same policy simulation as in scenario 1 in Table 4.2 leads to a drop in overall revenue by 0.6 percent. This is because the VAT is levied on a smaller production base (with activities going underground in response to the commodity tax hike). In scenarios 2, 3 and 4 with a uniform tariff of 5 percent matched by increasing rates of VAT, the net increase in total revenue is less than in Table 4.2 for identical simulations. While scenario 5 raised total tax revenue by 4 percent, as in Table 4.2, the increase in revenue is only 0.5 percent in the presence of an enlarged informal sector.

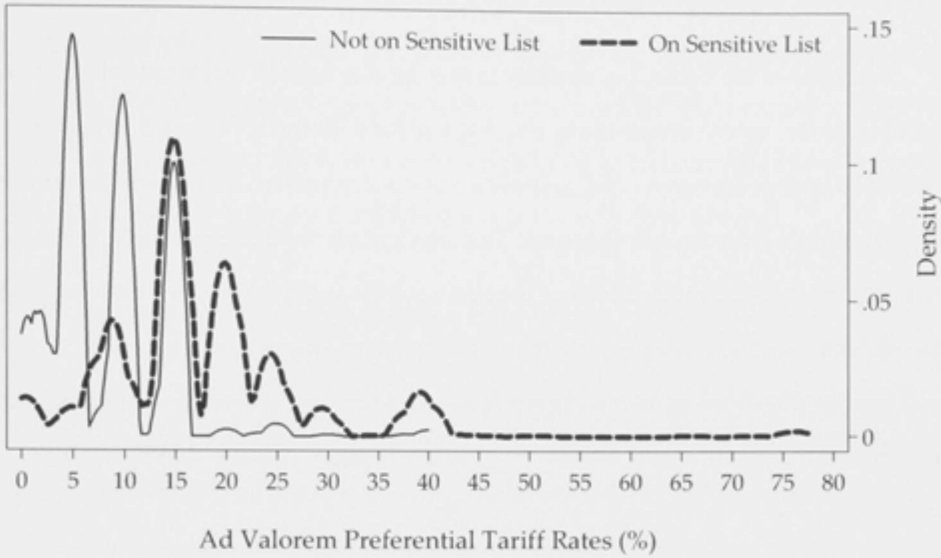
Ideally, the size of the informal sector ought to respond endogenously to the tax system. However, discussion of this is beyond the scope of this section whose the goal is to illustrate that i) it is costly to raise taxes on a narrow base and ii) revenue loss from a switch in trade to domestic commodity taxes is minimized when imports form an important part of the domestic tax base. In extreme cases, such a coordinated tariff and tax reform could merely lead to a replacement of tariff by VAT and excise at the border. There will, however, be a substantial difference made to production efficiency in the formal sector by switching to VAT and excise. Furthermore, while the VAT generally only taxes the informal sector if it consumes inputs from the taxed formal sector, this is not the case when imports are a large part of the VAT base when it can tax informal sector sales, as well as profits of formal sector firms (Boadway & Sato 2009).

4.3.4.3 *Regional Free Trade without Sensitive Lists*

The second set of policy scenarios addresses the Tariff Liberalization Program, as spelled out in Article VII of SAFTA, launched in 2006 with the aim of establishing a free trade zone among the eight countries of South Asia (SAARC 2006).[35] What is foreseen by SAFTA is a preferential area where most goods would be traded at tariff levels between zero and five percent by 2016. Pakistan, India and Sri Lanka are not Least Developed Countries (LDCs) according to a United Nations defini-

35 The members are Afghanistan, Bhutan, Bangladesh, India, Maldives, Nepal, Pakistan and Sri Lanka.

Figure 4.3: Dispersion of Tariff Rates



Source: Government of Nepal (2009b)

tion,[36] and they follow a faster schedule of tariff liberalization than the other five, with tariffs reduced to at most five percent by 2013.

All members of SAFTA are permitted to maintain a Sensitive List (SL) of exports that are exempt from tariff cuts. This is often at odds with the WTO's GATT that sets out rules for the negotiation of customs unions and free trade areas. Article XXIV of GATT allows regional trading arrangements to be set up as a special exception to the MFN rule if tariffs and other barriers are eliminated for substantially all the trade. There is, however, no agreement on what numerical share of trade constitutes "substantially all."

Table 4.4 shows impacts on Nepali imports, tariff revenue, and total tax revenue from implementing various tariff and VAT changes in relation to trade in the South Asia region. India accounts for over 63 percent of imports and the six other South Asian countries collectively account for less than 0.5 percent (Table

36 See United Nations (2011).

4.12). Thus, from the perspective of Nepali imports, free trade in South Asia is equivalent to free trade with India.

Scenario 1 in Table 4.4 applies tariffs at the agreed preferential rates with no exemption while eliminating the Agricultural Reform Fee, and other charges like fines and demurrage. VAT and excise are not adjusted, and tariffs on countries outside South Asia are not changed. This modest incremental reform appears to be roughly revenue-neutral. In other words, simply applying agreed statutory rates on imports and eliminating tariff exemptions on imports from South Asia can pay for the elimination of the Agricultural Reform Fee currently levied on Indian agricultural imports. This would require no further change to the domestic tax regime.

Scenario 2 simulates complete free trade with South Asia while keeping tariffs on imports from the rest of the world unchanged. Further, the existing VAT rate of 13 percent is enforced strongly on all imports and domestically produced goods. This scenario is unfavorable to Nepal as total tax revenue drops from Rs. 60 billion to Rs. 56.4 billion (by more than six percent). This indicates that even the full force of a perfectly implemented VAT at the existing rate is not sufficient to recoup tariff revenue loss of more than 62 percent (from Rs. 15.6 billion to Rs. 5.9 billion) as a consequence of free trade with the rest of South Asia. Scenario 3 shows, however, that a VAT of 15 percent is adequate to make up for the revenue cost of free trade with South Asia. Net tax revenues increase by 4.5 percent.

In scenario 4, I foresee complete free trade within South Asia, enforcement of the VAT at 15 percent, elimination of ARF and other charges, and application of a uniform tariff of eight percent on imports from the rest of the world. This is almost equivalent to scenario 3, except that under this scenario, applied weighted tariff increases from 2.6 percent to 2.8 percent. In other words, scenario 3 is slightly more protectionist, but administratively simpler because there are only two tariff rates to enforce: zero percent for South Asian imports and eight percent for the rest.

Scenario 5 extends SAFTA to include China, envisioning a free trade area around Nepal that is peopled by 2.5 billion consumers. Interestingly, zero tariffs on all Indian and Chinese imports can be compensated by the full application of the VAT at 15 percent. Because China and India accounted for three-quarters of Nepali imports in 2008, reducing all tariffs on them to zero reduces the trade-weighted collected tariff (rate of protection) from seven to under two percent.

4.3.4.4 *Regional Free Trade with Sensitive Lists*

The Sensitive List shields products from tariff cut commitments on the basis of self-defined national interest. Among the members of SAFTA, Nepal maintains the longest list of sensitive products that are exempt from progressive tariff cuts (Table 4.13). By 2016, only products that are not on the Sensitive List whose tariffs will be confined to between zero and five percent.[37] Of the 1295 products (at the HS 6-digit level) on Nepal's Sensitive List of imports from the larger South Asian economies (India, Pakistan, Sri Lanka), more than 250 were not even imported into the country in 2008. The average tariff level of products on the Sensitive List is higher than those not on the list, as shown in Figure 4.3. For products on the list, there is a noticeable "bunching" around the rates of 15, 20, 25 and 40 percent, whereas for products not on the list, the densities are higher at lower tariff rates of five and 10 percent.

Scenario 1 in Table 4.5 presents the revenue baseline when there is free trade with South Asia (with tariffs and other taxes, but not excise, eliminated). The existing pattern of VAT is unchanged, as are tariffs on the rest of the world. Predictably, with 63 percent of total imports rendered duty-free, tariff revenues collapse by nearly 62 percent, and overall government revenues are reduced by 22.4 percent. Trade-weighted average applied tariff rate also drops from seven to 2.6 percent. The difference with scenario 2 in Table 4.2 is that in the latter, tariff cuts are accom-

37 In South Asia, Bhutan has the shortest list, followed by India's list for LDCs. India's list for Pakistan and Sri Lanka is much longer (SAARC 2011).

panied by full enforcement of the existing VAT rate, leading to an overall revenue decline of only 6.1 percent.

Scenario 2 repeats the previous simulation, but allows no tariff cuts on products on the government's existing Sensitive List. Tariff is not reduced to zero on 1092 products (but other taxes including the ARF are eliminated). This limits revenue loss from imports to only about 10 percent, and when revenue from domestic production is allowed for, the government revenue drops by only 7.9 percent. The existing Sensitive List, therefore, protects revenue by nearly 15 percentage points. The down-side of this is that the trade-weighted average applied tariff rate has only dropped by 0.9 percentage points, from the pre-reform seven percent to the post-reform 6.1 percent. This suggests that while Nepal has signed up for freer trade, it is exhibiting anxiety about the consequences by using a lengthy Sensitive List that is legally sanctioned but operationally detrimental to the ethos of freer trade.

In scenario 3, I prepare an *alternative* Sensitive List with 1096 products at the HS 8-digit level (same number as the government's existing list) with the sole objective of minimizing revenue loss from intra-regional free trade. The alternative Sensitive List is prepared in two steps. First, I simulate a policy scenario corresponding to unconditional free trade. Second, I look at the final revenue changes at the product level subsequent to the three channels of adjustment described in Section 3, and sort products by the amount of tariff revenue loss. The top 1096 products with the highest losses are then put on the Sensitive List. The list prepared in this manner preserves revenues by an additional 3.4 percentage points over and above the government's list. Indeed, tariff revenues *increase* under this scenario; it is only after accounting for the loss of other taxes that total revenue falls from Rs. 60 billion to Rs. 57.3 billion. The consequence of applying such a conservative Sensitive List is that there is no meaningful reduction in distortion from trade taxes as a result of intra-regional free trade. The trade-weighted average applied tariff rate stays unchanged at seven percent.

Scenarios 2 and 3 do not lead to as big a revenue loss as under complete intra-regional free trade because the Sensitive Lists are devised by counting the number of tariff lines. This approach is irrespective of the magnitude of the share of individual imports, and all high value tariff lines can be shielded from cuts. Indeed, the government's Sensitive List covers 50 percent of all imports, and my alternative list covers 84 percent of imports. This suggests that if the purpose of a regional free trade agreement is to foster regional trade, either the Sensitive Lists ought to be scrapped, or capped by value, in line with Article XXIV of GATT that permits an exception to the WTO's sacrosanct MFN principle (GATT Article I) only if regional trade blocs cover substantially all the trade among members.

Next, I examine the revenue consequences of free trade with South Asia when Nepal is permitted to design a Sensitive List that cumulatively accounts for 5, 10, and 20 percent of trade value. In other words, "substantially all the trade" is interpreted as 95, 90, and 80 percent of total imports, respectively.

Scenario 4 caps the cumulative import value of products in the Sensitive List at 20 percent. This list was created by adding the share of revenue changes normalized by the import value of each product from the South Asia region. Although this list is longer, in terms of the number of tariff lines shielded, than in the preceding two scenarios, capping the value at 20 percent frees up many high-value import categories that are now subject to tariff cuts. Overall revenue in this case decreases by 10.4 percent. Scenario 5 caps import value at 10 percent, leading to overall revenue loss of 13.8 percent. Scenario 6 caps the Sensitive List at five percent of import value, leading to a loss in revenue of 18.1 percent (Rs. 11 billion), which is more than under complete intra-regional free trade (scenario 1). In these simulations, the weighted average rate of collected tariffs halve, from 7 to 3.5 percent.

The simulation results reported in Table 4.5 illustrate that the design of Sensitive Lists is crucial, with potential for either fostering or frustrating the objective of regional free trade. Sensitive Lists that are carved out by counting tariff lines appear to undermine the objective of intra-regional free trade more than when such lists shield products by value. In all cases, revenue losses are big, but as shown in Table 4.4, these can be recouped through reforms to the domestic tax regime, especially a full and effective implementation of the VAT at existing or slightly higher rates.

4.3.5 *Robustness*

In this section, two major simulations from Tables 4.2 and 4.4 are re-run allowing for higher elasticities. Scenario 1 of Table 4.10 uses default elasticities and is identical to scenario 1 of Table 4.2 where the reform consists of a 50 percent cut in statutory tariffs on all imports from all countries matched by an effective 13 percent VAT on all goods. Scenario 2 repeats this simulation with higher elasticities: three for export substitution and two for domestic substitution, with demand elasticity applied at the *disaggregated product level* using the estimates of Kee et al. (2008). Scenario 3 repeats scenario 2, with an additional increase in only the exporter substitutability parameter from three to six.

The results in scenarios 2 and 3 of Table In Table 4.10, compared to scenario 1, confirm that the responsiveness of imports to relative price changes is increasing in substitutability. Compared to the default case, imports increase by two percentage points, which reduces the loss in tariff revenue by 5.8 percentage points. Overall tax revenue increases by 3.3 percentage points when elasticities increase.

Scenarios 4 to 6 simulate the revenue consequences – under varying sets of elasticities – for free trade under SAFTA with a Sensitive List that I create to cap imports under exemption to not exceed 10 percent of total import value from South Asia. This reform is closer to the spirit of freer regional trade, but it leads to greater revenue losses. Consistent with the previous set of simulations, revenue losses are decreasing in elasticity: the higher the degree of substitution allowed in response to import and domestic prices, the smaller the decline in revenue.

Table 4.2: Revenue Impact of Tariff and Tax Reform

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Reforms	*Tariff cut 50%* *Full VAT 13%*	*Uniform tariff 5%* *Full VAT 13%*	*Uniform tariff 5%* *Full VAT 15%*	*Uniform tariff 5%* *Full VAT 17%*	*No tariff* *Full VAT 17%*
Impact on Imports					
Imports pre	222.1	222.1	222.1	222.1	222.1
Imports post	222.8	221.3	219.0	216.7	223.1
% change in imports	0.3%	-0.4%	-1.4%	-2.5%	0.4%
Impact on Revenue					
Tariff revenue pre	15.6	15.6	15.6	15.6	15.6
Tariff revenue post	9.6	11.1	10.9	10.8	0.0
% change in tariff revenue	-38.3%	-28.9%	-29.6%	-30.4%	-100.0%
Total Tax Revenues on Imports					
Total revenue pre	45.4	45.4	45.4	45.4	45.4
Total revenue post	43.0	44.1	48.3	52.4	40.8
% change in total revenue	-5.2%	-2.7%	6.5%	15.6%	-10.1%
Total Tax Revenues on Imports and Domestic Production					
Total tax revenue pre	60.0	60.0	60.0	60.0	60.0
Total tax revenue post	60.6	61.6	68.0	74.2	62.4
% change in total tax revenue	1.0%	2.7%	13.3%	23.7%	4.0%
Collected Tariff Rate					
Collected applied tariff rate pre	7.0%	7.0%	7.0%	7.0%	7.0%
Collected applied tariff rate post	4.3%	5.0%	5.0%	5.0%	0.0%

Note: All values in billions of Rupees

Table 4.3: Revenue Impact of Tariff and Tax Reform (Informal Sector)

	Scenario 6	Scenario 7	Scenario 8	Scenario 9	Scenario 10
Reforms	*Tariff cut 50%* *Full VAT 13%*	*Uniform tariff 5%* *Full VAT 13%*	*Uniform tariff 5%* *Full VAT 15%*	*Uniform tariff 5%* *Full VAT 17%*	*No tariff* *Full VAT 17%*
Impact on Imports					
Imports pre	222.1	222.1	222.1	222.1	222.1
Imports post	222.8	221.3	219.1	216.8	223.1
% change in imports	0.3%	-0.4%	-1.4%	-2.4%	0.4%
Impact on Revenue					
Tariff revenue pre	15.6	15.6	15.6	15.6	15.6
Tariff revenue post	9.6	11.1	11.0	10.8	0.0
% change in tariff revenue	-38.3%	-28.9%	-29.6%	-30.3%	-100.0%
Total Tax Revenues on Imports					
Total revenue pre	45.4	45.4	45.4	45.4	45.4
Total revenue post	43.0	44.1	48.4	52.5	40.8
% change in total revenue	-5.2%	-2.7%	6.6%	15.6%	-10.2%
Total Tax Revenues on Imports and Domestic Production					
Total tax revenue pre	55.6	55.6	55.6	55.6	55.6
Total tax revenue post	55.3	56.4	62.1	67.7	55.9
% change in total tax revenue	-0.6%	1.4%	11.7%	21.8%	0.5%
Collected Tariff Rate					
Collected applied tariff rate pre	7.0%	7.0%	7.0%	7.0%	7.0%
Collected applied tariff rate post	4.3%	5.0%	5.0%	5.0%	0.0%

Note: All values in billions of Rupees

Table 4.4: Revenue Impact of Regional Free Trade

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Reforms	*Stat. tariff*	*Zero tariff*	*Zero tariff*	*Zero tariff*	*SAFTA and China zero tariff*
	No ARF	*No ARF*	*No ARF*	*Uniform 8% on ROW*	*Uniform 8% on ROW*
	Existing VAT	*Full VAT 13%*	*Full VAT 15%*	*Full VAT 15%*	*Full VAT 15%*
Impact on Imports					
Imports pre	222.1	222.1	222.1	222.1	222.1
Imports post	222.4	224.5	222.3	221.6	222.7
% change in imports	0.1%	1.1%	0.1%	-0.2%	0.2%
Impact on Revenue					
Tariff revenue pre	15.6	15.6	15.6	15.6	15.6
Tariff revenue post	18.0	5.9	5.8	6.1	4.3
% change in tariff revenue	15.7%	-62.1%	-62.5%	-60.5%	-72.3%
Total Tax Revenues on Imports					
Total revenue pre	45.4	45.4	45.4	45.4	45.4
Total revenue post	45.3	38.9	43.1	43.2	41.2
% change in total revenue	-0.1%	-14.3%	-5.0%	-4.8%	-9.2%
Total Tax Revenues on Imports and Domestic Production					
Total tax revenue pre	60.0	60.0	60.0	60.0	60.0
Total tax revenue post	60.1	56.4	62.7	62.8	60.8
% change in total tax revenue	0.2%	-6.1%	4.5%	4.6%	1.3%
Collected Tariff Rate					
Collected applied tariff rate pre	7.0%	7.0%	7.0%	7.0%	7.0%
Collected applied tariff rate post	8.1%	2.6%	2.6%	2.8%	1.9%

Note: All values in billions of Rupees

Table 4.5: Revenue Impact of Regional Free Trade (Sensitive List)

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Reforms	*No SL* *Existing VAT* *No ARF*	*Existing Govt. SL* *Existing VAT* *No ARF*	*Alternative SL* *Existing VAT* *No ARF*	*20% shielded in SL* *Existing VAT* *No ARF*	*10% shielded in SL* *Existing VAT* *No ARF*	*5% shielded in SL* *Existing VAT* *No ARF*
Impact on Imports						
Imports pre	222.1	222.1	222.1	222.1	222.1	222.1
Imports post	228.5	224.9	223.9	225.7	226.7	227.8
% change in imports	2.9%	1.2%	0.8%	1.6%	2.1%	2.5%
Impact on Revenue						
Tariff revenue pre	15.6	15.6	15.6	15.6	15.6	15.6
Tariff revenue post	5.9	13.6	15.6	12.2	10.4	8.0
% change in tariff revenue	-61.9%	-12.4%	0.2%	-21.6%	-33.4%	-48.8%
Total Tax Revenues on Imports						
Total revenue pre	45.4	45.4	45.4	45.4	45.4	45.4
Total revenue post	32.1	40.6	42.7	39.2	37.2	34.6
% change in total revenue	-29.4%	-10.4%	-5.9%	-13.7%	-18.0%	-23.7%
Total Tax Revenues on Imports and Domestic Production						
Total tax revenue pre	60.0	60.0	60.0	60.0	60.0	60.0
Total tax revenue post	46.6	55.2	57.3	53.7	51.7	49.1
% change in total tax revenue	-22.4%	-7.9%	-4.5%	-10.4%	-13.8%	-18.1%
Collected Tariff Rate						
Collected applied tariff rate pre	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
Collected applied tariff rate post	2.6%	6.1%	7.0%	5.4%	4.6%	3.5%

Note: All values in billions of Rupees

Note that the difference between scenarios 2 and 3 and between 5 and 6 lies only in the exporter substitution elasticity. In the case of coordinated tax and tariff reform, *all* tariffs are cut and domestic tax is enforced on *all* goods. If there was no exemption on any good, this reform would not have triggered any substitution among exporters. Any increase in imports would be a result of final domestic price changes leading to increased demand for all products irrespective of origin. Because the existing VAT is not applied uniformly, the reform does lead to relative price changes, permitting some substitutability in imports by destination. The overall effect is that higher *exporter* substitutability (everything else being equal) leads to greater import response, tariff revenue, and total tax collection.

In scenarios 4, 5, and 6, however, the reform entails a radical cut in tariffs on imports from South Asia only. When all elasticities increase in tandem, the net loss of revenue is less than under the default case. This is consistent with previous simulations where higher elasticities led to greater substitutability and import demand in response to overall price fall. However, when I increase *only* the exporter substitutability elasticity in scenario 6, overall tariff and tax revenues decrease by more than in scenario 5. The reason for this is that as a result of tariff elimination within South Asia, there is substitution of imports away from the rest of the world. But there is no tariff earned on South Asian imports under free trade. Because tariffs are part of the VAT base, elimination of tariffs leads to a further fall in revenue from VAT.

4.4 RELATED ISSUES IN TARIFF REFORM

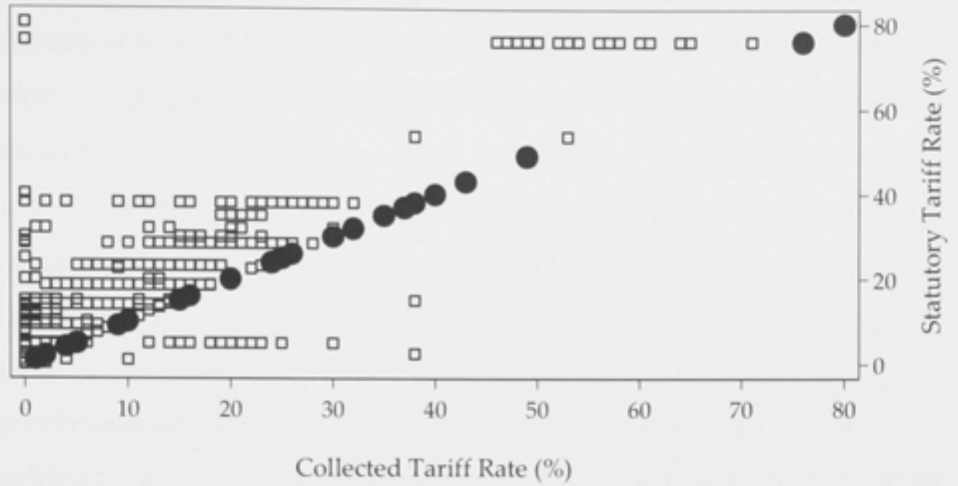
4.4.1 *Change in Domestic Prices and Production*

Together with the revenue consequences, TRIST simulations indicate the extent to which domestic production is substituted for by imports when the latter become cheaper as a result of tariff cuts. Products are clustered by sector at the ISIC 3-digit level. In my data set, domestic production figures are only available for broadly-defined manufacturing industries. Because inter-sectoral cross-linkages are not incorporated in this model, the projected change in average prices and production apply to each sector only.

Table 4.11 shows the value of domestic sales before and after Nepal applies zero tariff on all imports from South Asia without and with exemptions (as in scenarios 1 and 2 of Table 4.5). Predictably, the transport and motor vehicle sectors undergo the biggest change as a result of reforms because these products attract some of the highest rates of tariff at present. Note that because high rates of excise duty and VAT are still applied on some of these products, average prices do not fall dramatically. For example, the rate of protection of the motor vehicle sector falls by 16 percentage points, but still remains at over 12 percent, unlike several other sectors where the rate of protection falls below three percent.

Table 4.11 disaggregates tariff revenue at the sectoral level. Among the top 10 sectors listed, the loss of tariff revenue is least pronounced in apparel and animal rearing sectors (ISIC 12 and 181). In the remaining sectors, tariff revenues fall by between 46 and 99 percent. If the government's highly liberal Sensitive List shields some of the products which are anticipated to experience big revenue changes (for example, motor vehicles), the picture of domestic price and production change would alter. This is shown in the bottom half of the same table. Transport equipment and motor vehicles are protected from tariff cuts in the government's existing Sensitive List, so modest changes in domestic sales occur in primary sectors (animal rearing, mining, forestry) and basic manufacturing industries. Change in the level of protection as well as tariff revenues is also less severe than in the case when no product is shielded from tariff cuts.

Figure 4.4: Statutory and Collected Tariff Rates



Source: Government of Nepal (2009b)
Note 1: Number of total observations is 256971
Note 2: 58421 observations where statutory rate > collected rate
Note 3: 36 observations where statutory rate < collected rate

4.4.2 *Collected and Statutory Rates*

Pritchett & Sethi (1994) found for some developing countries[38] that collected (applied) tariff rates are only weakly correlated with statutory rates and that the former decrease non-linearly as the latter rise. This reflects the problem of granting tariff exemptions discretionarily, and opening up opportunities for graft. Revisiting Nepal's import data for 2008, I find that the issue of a discrepancy between statutory and collected tariff rates is less important for Nepal. This is perhaps the effect of the sustained tariff reforms over the past 20 years that have focused on lowering the average rates as well as reducing the number of tariff bands through policy reforms supported by international organizations like the World Bank, IMF, and the WTO.

Table 4.14 lists the mean rate of collected tariff and its dispersion at selected statutory rates. However, except at the highest rate of 80 percent, applied tariff

38 Their data are for Jamaica (1991), Kenya (1987) and Pakistan (1991).

rates are only marginally less than statutory rates, indicating a high degree of compliance on average. When individual import transactions are parsed, however, the degree of discrepancy appears wider. Figure 4.4 depicts this graphically where 23 percent of import transactions (out of 256,971) paid tariffs that did not match the statutory tariff rate. If the collected tariff rate is less than the statutory rate, it could mean either of the following: i) tariffs were legally sacrificed as part of a conscious government decision, such as import duty rebates as part of an export promotion strategy, ii) other para-tariffs have been introduced in lieu of, or on top of, tariffs, such as the Agricultural Reform Fee, or iii) there is malpractice in the customs administration where authorities exercise improper discretion and exempt certain imports from tariffs and taxes. In a negligible number of cases, collected tariff rates are actually *higher* than the ad valorem statutory rates.[39]

If all importers paid the statutory rate, it would be a perfect predictor of the collected tariff rate in a simple regression of applied tariff on statutory tariff. In Nepal, the explanatory power (R^2) of the latter on the former is higher (0.82) than that found by Pritchett & Sethi (1994). Further, a spline regression that allows for different slopes for two subsets of tariff rates (below and above 25 percent), and a quadratic regression of applied rate on statutory rate and its squared value demonstrate a high explanatory power, confirming that the correlation between statutory and collected tariff rates for Nepal is strong, but collected tariff rates do *decline* as statutory rates rise.

Related to this is the issue of smuggling and under-invoicing. If statutory tariff rates and other border taxes are higher than the cost of smuggling, they provide incentives for smugglers to evade high tariffs. Since smuggling is not costless (it takes resources to arrange for successful smuggling, and face the law if caught), lowering of ad valorem tariffs decreases the incentives for smuggling.

39 This could be a result of specific decrees, or that these imports could be akin to personal effects that are generally charged a high tariff but no VAT. In 2008, there were 36 such items, 30 of which belonged to HS 3706 (Cinematography film). Note also that records corresponding to the high statutory rate of 80 percent applying largely to motor vehicles show that a number of exemptions were granted to parties that were neither government nor diplomatic establishments.

Importers also have an incentive to collude with exporters to under-invoice their import value in order to pay less tariffs when duties are ad valorem. An intuitive solution for this is to levy specific tariffs, and not ad valorem, but specific tariffs have their own complications. The more important point is that both the problem of under-invoicing and smuggling are partly triggered by a cascading tariff structure where final goods attract high tariffs and intermediate goods attract low tariffs. Across-the-board lowering of tariffs could therefore encourage more goods to flow through formal channels, increasing tariff revenue.

4.5 CONCLUSION

Tariffs have historically served the dual purpose of raising government revenue and protecting domestic producers. This was clearly seen in many developing countries when they experimented with import substitution policies behind high tariff walls in the post-war period.[40] In recent decades, the economic paradigm has shifted decisively towards greater liberalization, diminishing the protective function of tariffs. In the poorest countries, however, the revenue-raising role of tariffs remains important. The short-term concern over loss of revenue, therefore, has often stymied necessary trade and fiscal reforms.

An ideal tax system raises revenue to fund socially sanctioned government expenditures in ways that are administratively and politically feasible while promoting equity and efficiency (Burgess & Stern 1993). As countries become richer, they move towards this ideal by relying more on direct sources of taxation on personal income. Because of capacity constraints and high enforcement costs, however, developing countries focus on narrow tax bases that not only distort incentives and

40 In the 19th century, tariffs were a major issue in the rich countries of the day as well. With no income taxes, and the popularly known Export Clause of the Constitution banning the levying of export duty, the United States relied heavily on tariffs. From South Carolina's Ordinance of Nullification (of tariffs) in 1832 that triggered a crisis over federal authority under President Jackson to the Great Tariff Debate of 1888, tariffs were a divisive political issue (Irwin 1997). In Britain, the repealing of tariffs on imported grain (Corn Laws) in 1846 by Prime Minister Robert Peel split the Tory Party and began a brief era of freer trade.

resource allocation, but also raise revenue that is inadequate to fund development needs.[41]

This paper contributes to the debate on ways to reform trade practices without adversely affecting the revenue base of poor countries. Cross-country evidence from 35 low-income countries shows that as countries move away from trade-based taxes, they manage to partially offset trade-based revenue losses with domestic sources of taxes. That the presence of VAT is not more strongly associated with revenue recovery is a surprise because this is not what the simulations suggest. This can only be resolved if we acknowledge the great heterogeneity in VAT regimes across countries, with efficacy dependent on factors beyond the ad valorem rate, such as the size of the informal sector, product coverage of the value-added tax, systems of tax refund, and the capacity of tax administrations.

Using actual data on import value, tariffs, and up to ten domestic taxes on more than 400,000 import transactions from Nepal, I develop scenarios in which tariffs can be cut with the least impact on total revenue. This requires eliminating widespread exemptions and an effective implementation of domestic taxes such as VAT and excise spanning a widened base. The degree of informality and the hard-to-tax sectors complicate tax replacement, but a measured approach to reducing tariffs and expanding consumption taxes could minimize adjustment costs. In the case of regional free trade, Sensitive Lists can be crafted judiciously to minimize the strain on revenue.

The overarching policy lesson is that in countries undertaking trade reform, it is necessary to identify alternative sources of revenue ex ante. This steers developing countries towards strengthening their domestic tax system rather than resisting reforms. The use of partial (or general) equilibrium models, under sensible assumptions, produces estimates that assuage fears about the scale of loss of

41 Consider a hypothetical scenario where a typical poor country raises taxes of around 12 percent of GDP. It raises another 3 percent of GDP in non-tax revenue. Add to it a fiscal deficit of 5 percent of GDP. It then has to meet its immense development challenges like poverty alleviation with a resource envelope of around 20 percent of GDP. (Note that the interest burden on annual borrowing alone, at 8 percent, would add 0.4 percent of GDP in subsequent years.)

revenue and production. The models contribute to evidence-based policy making on the parameters of reform such as tariff-cutting formulae, schedules of products to exempt, and sectors to help temporarily. This is a period unprecedented in world history when countries *at all income levels* are engaged in simultaneous trade negotiations at the multilateral, regional, and bilateral levels. The utility of swift, time-sensitive analyses of trade adjustment costs, as attempted in this paper, could therefore be high.

APPENDIX

4.A HOW THE MODEL IN TRIST WORKS

This illustration simplifies Brenton et al. (2011) to a case where there are only three exporting countries (a, b, c), one exportable product (j), and an importing home country (h). (The real world simulations in this paper involved 133 exporting economies and 4032 products.) Existing imports from each country are multiplied by the price change (Δp_{ij}) from equation 4.13, and adjusted by the elasticity of substitution (σ^{ES}) between imports. Total imports $\sum_n q_{ij} = (q_{aj} + q_{bj} + q_{cj})$ are held constant to isolate the substitution effect. Total import from each country after price change and substitution is:

$$q_{ij}^{ES} = (1 + \sigma^{ES}\Delta p_{ij}) * q_{ij} \cdot \frac{\sum_n q_{ij}}{\sum_n (1 + \sigma^{ES}\Delta p_{ij}) * q_{ij}} \tag{4.A.1}$$

Second, price change in imports relative to domestic price affects the allocation of expenditure between imports and domestically produced goods. As a result of the reform, the change in the weighted average price of imports $(\triangle P_j)$ is the change in each price multiplied by that import's share in total imports:

$$\triangle P_j = \sum_n \left[\frac{q_{ij}}{\sum_n q_{ij}} * \Delta p_{ij} \right] \tag{4.A.2}$$

Total consumption (Q^D) at home consists of imports from the three countries and domestic production. So, $Q^D = q_{hj} + \sum_n q_{ij}$. Given that the elasticity of substitution between imports and domestic good is σ^{DS}, the import of each good after domestic substitution is:

$$q_{ij}^{DS} = (1+\sigma^{DS}\triangle P_j) * q_{ij}^{ES} \cdot \frac{Q^D}{\sum_n (1+\sigma^{DS}\triangle P_j) * q_{ij}^{ES}} \tag{4.A.3}$$

Third, the weighted average price of imports is adjusted by the share of imports in total consumption. Because the price of domestically produced import-competing product has not altered, the average change in the domestic price of good j is deflated by the share of imports in total domestic consumption. If there is no domestic production, the whole change in price as a result of tariff cut is passed on to domestic consumers.

$$\triangle\widetilde{P_j} = \sum_n \left[\frac{\sum_n q_{ij}}{Q^D}\triangle P_j\right] \tag{4.A.4}$$

In response to domestic price change $(\triangle\widetilde{P_j})$, consumers now allocate their budget to imports *and* home products. Given the price elasticity of demand (σ^P), total demand $(Q^{D'})$ for good j supplied by each of the three exporting nations and domestic producers is:

$$Q^{D'} = (1+\sigma^P\triangle\widetilde{P_j}) * q_{ij}^{DS} \tag{4.A.5}$$

These steps are shown numerically in Table 4.6 with a hypothetical example, as follows.

A product is imported from Countries A and B valued at 100 and 200 units, respectively. The importing country levies a tariff of 30 percent, VAT of 10 percent, and an excise duty of 5 percent (not shown). Suppose, as a result of a free trade agreement with Country B, the tariff on imports from that country is dropped to zero percent. The ratio of old domestic to world price for the same product from Country B drops from 1.50 to 1.16. The import from Country A sees no change in price because neither its tariff nor domestic taxes have altered. Because the price of the good from Country B has dropped by 23.1 percent, imports from that country rise. By how much depends on the exporter substitutability elasticity. At the default value of 1.5, imports from Country B rise from 200 to 218.8, and those from Country A fall from 100 to 81.3, keeping the pre-reform import volume intact.

Because Country B's share in the home country's import of the product is two-thirds, the weighted drop in the import price is 15.4 percent. Now, there is substitution away from domestically produced goods towards imports from Country B *as well as* Country A. The exact magnitude of this shift depends, again, on the elasticity of domestic substitution. At the default value of 1, the value of imports from Country B rises to 228.9 and from Country A rises to 85 whereas home production falls from 150 to 136.

Finally, because domestically produced goods meet only one-third of total consumption needs at home, the weighted average domestic price of the good falls by 10.3 percent as a result of the 23.1 percent drop in the price of the import from a country that contributes to 45 percent of demand at home. In response, at the assumed price elasticity of 0.5, demand for imports from all three suppliers increases, from 228.9 to 240.7 in Country B, from 85 to 89.4 in Country A, and from 136 to 143 at home. After the reform, total consumption increases from 450 to 473.1. Among the suppliers, Country B (on whose product tariff was cut) benefits the most.

Table 4.6: Illustration of Price and Demand Response in TRIST

	Import from Country A	Import from Country B	Domestic Production
Price change			
Initial tariff (%)	**30**	**30**	
New tariff (%)	**30**	**0**	
VAT (%)	**10**	**10**	
Initial domestic to world price ratio	1.50	1.50	
New domestic to world price ratio	1.50	1.16	
Change in import price (%)	0.0	-23.1	
Import response in three steps			
1. Exporter substitution			
Initial product value	**100**	**200**	
Price change (%)	0.0	-23.1	
Intermediate step	100.0	269.2	
Value after exporter substitution	81.3	218.8	
2. Domestic substitution			
New product value	81.3	218.8	**150**
Price change (%)	0.0	-23.1	.
Average domestic price change of imports	-15.4	-15.4	*0*
Intermediate step	93.8	252.4	*150.0*
Value after domestic substitution	85.0	228.9	*136.0*
3. Demand			
Latest product value	85.0	228.9	*136.0*
Average domestic price change of imports (%)	-15.4	-15.4	.
Average domestic price change (%)	-10.3	-10.3	*-10.3*
Final demand at home	**89.4**	**240.7**	**143.0**

Note: This is a hypothetical example prepared by the author

4.B TABLES

Table 4.7: Tariff Rates and Import-based Revenue in Nepal, 2008

	Collected tariff	Excise duty	Value-added tax	Other taxes
Revenue (billions of Rupees)	**15.6**	**3.0**	**23.9**	**2.9**
Share of total tax revenue (%)	34.28	6.58	52.73	6.41
Simple average of tariff/tax rates (%)	10.54	0.58	11.03	1.89
Weighted average of tariff/tax rates (%)	7.00	1.26	9.94	1.31

Source: Government of Nepal (2009b)

Table 4.8: VAT Collected on Imports, 2005-2010

	2005-06	2006-07	2007-08	2008-09	2009-10
Revenue from VAT (billions of Rupees)	**21.61**	**26.10**	**29.82**	**39.70**	**54.92**
Collected on imports	*13.46*	*16.46*	*19.01*	*25.78*	*34.54*
Collected on domestic consumption	*8.15*	*9.63*	*10.81*	*13.92*	*20.38*
VAT Revenue from imports (%)	62.29	63.09	63.75	64.94	62.89

Source: Government of Nepal (2010)

Table 4.9: Tariff Revenue by Band, 2008

Band (%)	Obs.	Import Value	Share (%)	Collected Tariff (%)	Statutory Tariff (%)
Non-SAFTA					
a. Zero	1397	16.2	7.3	0.1	0.1
b. 0 to 5	3795	34.0	15.3	6.5	5.6
c. 5 to 15	4990	21.2	9.5	15.7	13.8
d. 15 to 30	1689	5.8	2.6	8.2	7.1
e. 30 to 80	447	1.9	0.9	7.2	6.5
f. Specific (AVE)	162	1.2	0.6	0.9	1.3
SAFTA					
a. Zero	609	15.8	7.1	0.0	0.0
b. 0 to 5	3491	45.9	20.7	10.9	9.5
c. 5 to 15	5690	25.2	11.3	9.7	14.1
d. 15 to 30	1424	7.5	3.4	6.1	9.5
e. 30 to 80	376	6.2	2.8	13.0	15.1
f. Specific (AVE)	259	41.3	18.6	21.7	17.5
Total	24329	222.1	100.0	100.0	100.0

Source: Government of Nepal (2009b)

Note: Import (in billions of Rupees) from 133 partners across 4032 tariff lines

Table 4.10: Revenue Impact of Tariff and Tax Reform (Robustness Tests)

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
	COORDINATED TARIFF AND TAX REFORM			SAFTA WITH SENSITIVE LIST (10% VALUE)		
Parameters						
Exporter and Dom. Elasticity	*1.5 and 1*	*3 and 2*	*6 and 2*	*1.5 and 1*	*3 and 2*	*6 and 2*
Demand Elasticity	*0.5*	*Kee et al. (2008)*	*Kee et al. (2008)*	*0.5*	*Kee et al. (2008)*	*Kee et al. (2008)*
Tariff cut	*50% on all*	*50% on all*	*50% on all*	*SAFTA duty-free*	*SAFTA duty-free*	*SAFTA duty-free*
VAT	*13% on all*	*13% on all*	*13% on all*	*Existing VAT*	*Existing VAT*	*Existing VAT*
Impact on Imports						
Imports pre	222.1	222.1	222.1	222.1	222.1	222.1
Imports post	222.8	227.0	227.2	226.7	239.4	239.5
% change in imports	0.3%	2.2%	2.3%	2.1%	7.8%	7.8%
Impact on Revenue						
Tariff revenue pre	15.6	15.6	15.6	15.6	15.6	15.6
Tariff revenue post	9.6	10.4	10.5	10.4	10.5	10.4
% change in tariff revenue	-38.3%	-32.9%	-32.5%	-33.4%	-32.4%	-33.2%
Total Tax Revenues on Imports						
Total revenue pre	45.4	45.4	45.4	45.4	45.4	45.4
Total revenue post	43.0	44.8	45.0	37.2	38.9	38.7
% change in total revenue	-5.2%	-1.2%	-0.9%	-18.0%	-14.4%	-14.7%
Total Tax Revenues on Imports and Domestic Production						
Total tax revenue pre	60.0	60.0	60.0	60.0	60.0	60.0
Total tax revenue post	60.6	62.6	62.8	51.7	53.6	53.4
% change in total tax revenue	1.0%	4.4%	4.6%	-13.8%	-10.8%	-11.0%
Collected Tariff Rate						
Collected applied tariff rate pre	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
Collected applied tariff rate post	4.3%	4.6%	4.6%	4.6%	4.4%	4.3%

Note: All values in billions of Rupees

Table 4.11: Change in Price, Production, Revenue, and Protection

		PRICE	DOMESTIC PRODUCTION		TARIFF REVENUE		PROTECTION	
ISIC	Description	*Change*	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*
With No Sensitive List								
359	Transport equipment n.e.c.	-19.73%	34,153,000	31,399,433	994,567,806	38,676,005	24.20%	0.90%
341	Motor vehicles	-12.99%	41,464,000	39,204,213	2,138,244,335	918,667,069	28.30%	12.20%
141	Quarrying of stone, sand and clay	-12.43%	47,421,000	45,091,897	82,464,005	2,583,235	13.90%	0.40%
142	Mining and quarrying n.e.c.	-17.51%	339,020,000	323,626,886	184,379,204	113,653	28.00%	0.00%
261	Glass and glass products	-8.99%	20,586,000	19,774,849	124,328,389	30,655,939	11.50%	2.80%
12	Farming of animals	-7.53%	18,700,000	18,093,203	397,635	328,896	0.20%	0.10%
20	Forestry, logging	-6.61%	140,000	135,715	4,321,501	1,612,831	7.30%	2.70%
269	Non-metallic mineral products	-14.66%	10,995,294,000	10,704,445,219	1,144,878,146	59,877,975	17.90%	0.90%
343	Parts and accessories for vehicles	-5.52%	30,000,000	29,246,069	53,985,555	24,714,072	7.50%	3.40%
222	Printing	-5.91%	18,826,000	18,394,321	12,190,961	6,569,016	11.00%	5.90%
With Sensitive List								
142	Mining and quarrying n.e.c.	-17.51%	339020000	323626886	184379204	113653	28.00%	0.00%
261	Glass and glass products	-8.26%	20586000	19841379	124328389	40587944	11.50%	3.80%
12	Farming of animals	-7.53%	18700000	18093203	397635	328896	0.20%	0.10%
20	Forestry	-6.61%	140000	135715	4321501	1612831	7.30%	2.70%
291	General purpose machinery	-3.80%	176639000	173603095	191972406	116474391	6.20%	3.70%
342	Vehicle bodies, trailers	-5.91%	13745000	13516473	2320123	1380290	12.00%	7.20%
315	Electric lamps and lighting equipment	-3.17%	41907000	41314225	51980453	43377661	9.80%	8.20%
271	Basic iron and steel	-3.63%	6414842000	6325053323	957951571	287136311	3.80%	1.10%
312	Electricity distribution apparatus	-2.92%	11228000	11072071	29201055	12864631	3.50%	1.60%
289	Fabricated metal products	-5.21%	1496438000	1475960021	154013435	79458131	8.60%	4.40%

Note: Top 10 sectors sorted by change in domestic production; values in Rupees

Table 4.12: Major Exporters to Nepal, 2008 & 2010

Partners 2010 (Source: COMTRADE)		Partners 2008 (Source: Government of Nepal)	
Economy	Value (US$m)	Economy	Value (US$m)
India	2900.0	India	2064.2
China	536.4	China	365.9
United Arab Emirates	456.8	Indonesia	104.8
Indonesia	110.7	Japan	76.6
Thailand	102.6	Singapore	76.5
United Kingdom	99.8	Thailand	64.7
Japan	85.7	Malaysia	56.7
Korea, Rep.	80.5	Argentina	51.0
United States	73.7	United States	46.4
Argentina	68.9	Germany	34.9
Singapore	68.5	Saudi Arabia	32.0
Australia	67.7	Korea, Rep.	30.7
Hong Kong, China	57.8	Taiwan, China	22.3
Malaysia	57.5	United Arab Emirates	21.5
Switzerland	37.5	United Kingdom	21.5

Note: Different sources and years used for check of consistency

Table 4.13: Number of Products in the Sensitive Lists

	In use as of 2010	Agreed reduction	In effect from November 2011
Afghanistan	1072	214	858
Bangladesh	1233*	246*	987*
	1241**	248**	993**
Bhutan	150	0	150
India	480*	96*	384*
	868**	173**	695**
Maldives	681	136	545
Nepal	**1257***	**251***	**1006***
	1295**	**259****	**1036****
Pakistan	1169	233	936
Sri Lanka	1042	208	834

Source: SAARC (2011); *For LDCs, ** For Non-LDCs

Table 4.14: Statutory and Applied Tariff Rates

Statutory Rate (%)	Mean Tariff (%)	St. Dev.	25th pct	75th pct	Total Obs.
5	4.92	1.37	5	5	53285
10	9.92	0.97	10	10	28254
15	14.88	1.31	15	15	49208
20	19.98	0.56	20	20	26221
30	29.47	3.68	30	30	3320
40	39.68	3.56	40	40	948
80	77.72	13.33	80	80	771

Source: Government of Nepal (2009b)

Table 4.15: Summary of Data used in Cross-Country Regressions

Variables	Obs.	Mean	St. Dev.	Min	Max	Source
Trade tax revenue relative to GDP (%)	933	4.15	4.10	0.04	33.33	IMF IFS
Imports relative to GDP (%)	950	34.00	20.32	0.12	148.58	IMF IFS
Export of natural resources per capita (log)	965	5.21	3.01	-5.15	12.22	World Bank
Oil and gas rent per capita (log)	1000	-2.02	3.24	-3.91	7.31	WDI
Per capita GDP (log)	943	5.78	0.55	4.52	7.25	WDI
Inflation (log)	804	2.21	1.18	-3.91	7.00	IMF IFS
Share of aid in GDP	938	12.48	10.43	0.05	94.92	WDI
Share of agriculture in GDP	906	33.59	12.12	4.21	68.88	WDI
VAT rates	1000	6.27	8.06	0	35	Author

Table 4.16: List of Countries and Related Tax Data

Country	Total Tax Rev. (1982-1986)	Total Tax Rev. (2002-2006)	Trade Tax Rev. (1982-1986)	Trade Tax Rev. (2002-2006)	VAT rate
Bangladesh	5.9	9.3	2.4	2.3	15
Benin	11.5	14.7	7.0	1.9	18
Bhutan	5.9	9.6	0.1	0.5	
Burkina Faso	11.4	11.2	4.7	1.6	18
Burundi	13.2	18.2	4.8	3.0	
Cameroon	19.4	21.3	3.8	2.2	19.3
Central African Republic	11.5	7.5	4.9	1.5	18
Chad	3.3	6.0	1.8	1.6	18
Comoros*	11.5	10.3	9.1	3.5	
Congo, Rep.	32.8	13.6	4.0	1.9	18.9
Cote d'Ivoire	19.9	14.9	8.6	4.8	18
Ethiopia	14.8	14.6	3.4	3.0	15
Gambia, The*	21.0	17.8	16.1	3.6	
Ghana	7.6	20.0	3.2	4.5	12.5
Guinea	14.5	11.0	2.3	2.1	18
Haiti	10.5	9.2	3.3	2.5	10
India	10.5	9.8	3.2	1.8	12.5
Indonesia	17.1	12.0	0.8	0.6	10
Kenya	23.1	18.6	5.4	1.7	16
Lesotho	37.3	39.7	27.2	21.7	14
Madagascar*	10.4	10.3	3.5	3.0	18
Malawi	17.5	21.5	4.1	2.8	17.5
Mali*	11.4	12.6	2.9	4.5	15
Mozambique	17.0	12.1	2.1	1.9	17
Myanmar*	8.7	3.4	2.3	0.4	
Nepal	6.9	10.1	2.3	3.1	13
Niger	9.1	10.0	3.9	4.9	19
Nigeria	16.1	15.3	2.2	3.3	5
Pakistan	14.6	11.4	5.8	1.8	15
Papua New Guinea	17.9	21.4	5.0	1.6	10
Rwanda	10.4	12.1	4.7	2.0	18
Sao Tome and Principe	25.1	21.2	10.6	5.4	
Senegal	15.3	16.9	6.3	3.0	18
Sierra Leone	11.0	12.0	5.4	5.8	
Solomon Islands	19.2	20.6	11.7	7.1	
Tanzania	16.3	12.7	1.4	1.1	20
Togo	22.1	14.2	7.1	6.8	18
Uganda	11.8	12.8	7.2	1.3	18
Zambia	21.5	17.1	4.0	2.1	17.5
Zimbabwe	24.8	24.5	3.9	2.4	15

Source: Tax data from Baunsgaard and Keen (2010);

VAT rates (in 2006) from Krever (2008), Ernst and Young (2008), and Doing Business indicators

Note 1: Revenue figures are relative to GDP (in percent)

Note 2: Average years of the second period for starred countries (*) is 1997-2001

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